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NASA Technology Utilization Program:  
The Small Business Market

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## EXECUTIVE SUMMARY

In 1977, the NASA-sponsored Transfer Research and Impact Studies (TRIS) Program staff at the Denver Research Institute initiated a continuing study to develop a better understanding for how various NASA technology transfer programs might be more useful to the small business community. This first report presents the initial results concerning the status, needs, and technology use patterns of small firms.

While exact numbers are not known, it has been estimated that over 13 million small businesses are operating in the United States. The Small Business Administration (SBA) and other agencies have developed various definitions of a small business which vary according to industry type, size of firm within an industry, gross sales and number of employees. For the purpose of this study, however, a definition provided in a report for the SBA will be used:

a business is considered small if it is independently operated, employs fewer than 500 employees, operates for profit and is involved in the creation or creative use of new knowledge, products, processes or services.

Small business, representing 97 percent of all business, is faced with a number of problems. The number one problem for the nation and especially small business is inflation, which in turn adds to other difficulties relating to research and development (R & D), capital availability, regulation and reporting requirements, taxes, innovation, and technology acquisition and application. Because of these problems and others, continued survival of the small business sector has been questioned. There is a widespread opinion that without help through legislation, government stimulation, and

sustained interest and effort by small business advocates, stability of the small business sector could be jeopardized.

Growth is considered the best assurance of a firm's ability to survive and growth is information dependent. Small businesses need a variety of information including marketing, management and technology. Individual small businesses have varied needs for technology, but all firms at some period of their growth will require new technology in order to remain competitive in product designs, processes or management methods.

While many information sources are available to small business, little is known about actual usage of these sources, especially by small manufacturer's, the largest potential market for NASA Technology Utilization (TU) Program services.

In a broad sense, there are three types of manufacturing firms within the small business sector and each has different technology needs. Type A firms which serve the needs of small pockets in the marketplace usually manufacture consumer goods. This type of firm generally would require minimum amounts of product, process and management technology. Type B firms serve as subcontractors or suppliers to large, mass production firms. Type B firms probably have the most varied needs for product, process and management technology--depending upon the industry, products, and rate of growth. Type C firms play a pioneering role in new industries and markets such as the solar industry. These are high technology firms whose growth is based on intense and continuous application of the most advanced technology.

Small businesses obtain new technology in several ways including internal R & D, government procurement contracts and through federal agencies such as NASA and the SBA.

Internal R & D is a valuable source of new technology, but it is performed almost exclusively by large firms. Lack of capital and fluctuations in the economy are only two of the reasons why small businesses reduce the amount they spend on R & D. The federal government sponsors over 50 percent of all R & D with over 80 percent carried out by only 200 large firms. However, small firms do act as subcontractors to the large firms.

Government procurement contracts offer the small firm opportunities to be in on the birth and growth of new technologies, training of their employees, and frequently, use of the new technology in commercial products. Some increases have already been made in the small business share of government procurement contracts and the proposed Small Business Innovation Act of 1979, if passed, will provide an additional one percent increase to the small business portion by each federal agency that budgets \$100 million or more to R & D.

Examples are given in the report to illustrate how NASA technology has been used successfully by small businesses. The transfer activity is described by transfer modes, or ways of acquiring the technology. The most important transfer modes for small business are contracts, personnel migration, and formal transfer services operated by the TU Program or by joint programs between the SBA and NASA.

The two most significant transfer services for small business are the Publications Program (e.g., the quarterly journal NASA Tech Briefs) and the Industrial Applications Center (IAC) network of computer-based search facilities. The Publications Program is the most thoroughly documented with respect to small business transfer activity. In 1979, almost two thirds of the 43,000 subscribers to NASA Tech Briefs were from facilities that employed less than

500 people. Some of these, however, are small installations of large corporations. About one third of the document requests through the Tech Brief Journal are from small manufacturers. A recent cost benefit study by the TRIS Program indicated that small businesses were about half as successful as large businesses in applying the NASA technology they receive through these two TU Program services. Other results from the cost benefit study are presented in this report to show small business use of these services.

In addition to Publications and IAC's, small businesses acquire NASA technology through other TU transfer services such as conferences, personal assistance, and interagency applications engineering projects. These services also generate successful transfer activity by small business but they have been used less often than Publications and IAC's so less data is available on success rates and patterns.

Several opportunities are described for enhancing the effectiveness of TU Program services to selected small business market segments. The success and failure patterns of Publications Program transfers, for example, can be analyzed for targeting further dissemination of selected publications to the most likely user groups in the small business sector. An initial experiment to test this Targeted Dissemination of Information (TDI) concept is being conducted by the TRIS Program. This appears to be the best single opportunity available for increasing small business benefits with a relatively small investment of TU Program funds.

Since management problems account for the majority of small business failures, increased efforts to report, package and disseminate the Agency's engineering management technology could also help small manufacturers to

cut costs and increase their survivability. At the same time, this effort could provide a way to familiarize the Agency's new small business contractors with NASA management practices and expectations.

Further study in several areas could provide information to develop additional improvements in the TU Program for accelerating the transfer of NASA technology to small business. R & D procurement contracts to small business might be used, for example, to stimulate growth of new industries consisting of small, competitive firms. Additional data and analysis to determine which types of small firms are most likely to use what sorts of technology through IAC services could enhance the effectiveness of this effort which appears to have a good potential for transferring NASA technology to small firms. A period of experimentation may be required to develop IAC information products with low production costs and high utility for selected groups of small businesses.

There are three reasons why NASA might consider developing a more active effort to enhance small business transfer activity. First, the TU Program can probably increase its cost benefit performance most easily by developing small business market segments for its services. Second, the Agency's procurement might be more cost efficient if competitive, small business industries could be developed through contracts to supply some types of products or services. Third, should successful methods be developed for transferring government technology to small businesses, they are potentially usable by other agencies for the same purpose. Although NASA technology will probably not produce major economic impacts in the small business sector, the TU Program can contribute significantly to a better understanding of how different transfer methods work simply by experimenting with various ways to pursue its dissemination goal.



## INTRODUCTION

A great deal of attention has been focused on the nation's small business sector. The evolving consensus of business, government, elected officials and others is that it needs help in order to ensure its continued survival.

Small business firms are ever challenged by a fluctuating economy, government regulation, limited capital, lack of incentives for research and development and management problems. They also have problems in the area of technology: acquiring it, applying it and profiting from it. NASA, through its Technology Utilization (TU) Program, may be able to help by disseminating technology appropriate to the needs of small business.

In 1977, the NASA-sponsored Transfer Research and Impact Studies (TRIS) Program staff at the Denver Research Institute initiated a continuing study to develop a better understanding for how various NASA technology transfer programs might be more useful to the small business community. This first report presents the initial results concerning the status, needs, and technology use patterns of small firms.

Previous research indicated that, among small businesses, manufacturing organizations are most likely to benefit from NASA technology. Therefore, a particular effort was made to examine the special needs of this large group in order to identify ways of enhancing NASA TU Program services for small manufacturers.

This report is divided into five sections. The first three sections--Small Business in the Economy, Small Business and Technology and Small Manufacturers and Technology Acquisition--summarize a large

amount of information from small business literature. The purpose of these sections is to provide an overview of small business with regard to its significance and role in the nation's economy. The fourth section--Small Business and Selected TU Programs--describes the economic benefits which small businesses typically receive through NASA's Publications Program and Industrial Applications Centers. The last section--Observations and Recommendations--relies on information from the previous sections to describe potential changes in program services for satisfying technological needs of this large market.

#### When Is a Business Small?

Thirteen million firms operating in the United States are described as small businesses.<sup>1</sup> No single definition of "small business," however adequately describes all of these firms. A number of definitions are used to serve the purposes of individual organizations and government agencies. Several of these definitions are given below.

Small business is generally defined as anything that isn't big business. A more complete interpretation in qualitative terms, however, has been offered by the Committee for Economic Development (CED). In their view, a business enterprise is small, if it possesses two or more of the following characteristics:

1. independent management (usually the managers are also the owners);

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<sup>1</sup>U.S. Chamber of Commerce, Center for Small Business. "Small Business Keeps America Working." Reprint of a commentary adapted from a 30-minute film produced for the U.S. Chamber of Commerce, Nation's Business (June 1979), p. 51.

2. owner-supplied capital;
3. mainly local area of operations and;
4. relatively small size within the industry.

It is these same characteristics which create many of the problems and some of the special needs of small business.<sup>2</sup>

The Small Business Administration (SBA), in addition to the first and fourth characteristics listed above, provides quantitative standards which vary according to industrial sector. For example, a manufacturing facility, depending upon the type of industry, is considered small with up to 1500 employees. In non-manufacturing industries, a small enterprise is defined according to gross sales, with various levels of sales volume for various industries: net sales of less than \$2 million to \$7.5 million is the total allowed for retail organizations; wholesale houses with net sales per year from \$9.5 to \$22 million qualify; while construction industries with less than \$9.5 million in annual receipts, special construction industries with average annual receipts of \$1 to \$2 million and agricultural firms with annual receipts under \$1 million are also considered small.<sup>3</sup>

These employee and dollar figures are periodically adjusted by the SBA to account for continued periods of inflation, or growth of larger firms in relation to small business.<sup>4</sup> The SBA has just proposed changes that would simplify the definition process by resetting standards for 750 industries based on the average number of employees over a 12-month

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<sup>2</sup>Baumback, Clifford M. And Kenneth Lawyer. How to Organize and Operate a Small Business, Englewood Cliffs, N.J.: Prentice-Hall, 1978, pp. 4-5.

<sup>3</sup>U.S. SBA. SBA Loans, Pamphlet #OPI-18, Washington, D.C.: Office of Public Information, March 1978.

<sup>4</sup>Ibid, reference #2, p. 4.

period and the amount of competition within each industry. These proposed changes would eliminate approximately 150,000 businesses from federal aid programs which the SBA believes may be causing small firms located in small business-dominated industries to compete among themselves. Primarily, the redefinitions would occur in retailing, service, farming and construction industries. Barber shops, as well as motorcycle and used-car dealerships, are typical firms that would no longer be considered small if more than 15 persons were employed. At the same time, to encourage competition in industries where large firms dominate, some businesses with up to 2500 employees would be redefined as small (e.g., oil refiners, copper mines, cotton mills, cereal producers and shipyards).<sup>5</sup> In its redefinition proposal, the SBA rated 160 industries as concentrated, 317 as competitive and 249 as mixed. Because small companies with fewer employees tend to be clustered in the more competitive industries, lower employee limits would be set for these companies in order to qualify them for SBA loan programs.<sup>6</sup> If the proposal is approved, the SBA estimates that 95 percent of all U.S. businesses would still be eligible for its aid programs.<sup>7</sup> It is expected that some revisions may be made in these proposed changes following public discussion and Congressional examination.<sup>8</sup>

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<sup>5</sup> Jackson, Brooks. The Wall Street Journal, Weds., March 12, 1980.

<sup>6</sup> The Denver Post, Sun., March 30, 1980, p. 45.

<sup>7</sup> Ibid, reference #6.

<sup>8</sup> Ibid, reference #5.

The Internal Revenue Code includes other definitional criteria that are used to determine a small business for tax purposes: gross receipts, number of owners, equity capital, income, and the size of a business interest as compared with a taxpayer's other assets.<sup>9</sup>

The most widely used standards to determine a small business are the number of employees and the gross sales volume.<sup>10</sup> For the purpose of this study, the "number of employees" will be the primary measurement. The definition presented in a 1978 report submitted to the Assistant Secretary of Commerce for Science and Technology will be used to define small businesses in this research project:

. . . those firms that have less than 500 employees, are not majority owned by larger firms, are operated for profit, and are involved in the creation or creative use of new knowledge, products, processes, or services.<sup>11</sup>

One last, very positive description offered by the U.S. Chamber of Commerce is included here:

Small business means growth and growth means jobs . . . Creating new products, expanding markets, fine-tuning technology, that's small business.<sup>12</sup>

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<sup>9</sup> Sampson, Michael P., "The Impact of Taxation on Small Business: A Proposal For Reform, "The Study of Small Business, Part III", Washington, D.C.: U.S. SBA Office of Advocacy, June, 1977, p. 34.

<sup>10</sup>Ibid, reference #4.

<sup>11</sup>Norris, William C., "Recommendations for Creating Jobs Through the Success of Small, Innovative Businesses," Small Business & Innovation, Washington, D.C.: U.S. SBA Office of Advocacy Task Force, May 1978, p. 1.

<sup>12</sup>Ibid, reference #1, p. 52.

## SECTION I. SMALL BUSINESS IN THE ECONOMY

Small business plays a basic role in the nation's economy by contributing substantial revenues and job opportunities. In addition, small business plays an important role in maintaining the free enterprise system. It competes directly with big business in many areas including: "price, credit terms, service, product improvement, inter-industry struggles concerning substitution, replacement" and development of innovative methods.<sup>13</sup>

At the same time, big and small businesses frequently have interdependent relationships. Some small service industries, for example, maintain the products of large mass-production industries, other small enterprises provide them with technical, professional and clerical services while small wholesale and retail outlets distribute their products. A large manufacturing firm, which obtains supplies and component parts for its production systems from small manufacturers,<sup>14</sup> in turn, provides a major market for many small manufacturers.<sup>15</sup>

New industries have historically emerged as a plethora of small companies with new product lines which died, got absorbed and/or grew to form mature industries with a few giant companies whose profits are mainly determined by economies of scale and process technology. This

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<sup>13</sup>Ibid, reference #2, p. 12.

<sup>14</sup>Ibid, p. 11.

<sup>15</sup>Ibid, p. 7.

growth process is not yet well understood although the federal government has legal responsibilities for maintaining a vigorous small business sector. Baumback and Lawyer note that federal officials have been concerned about "vertical and horizontal integrations in large companies" and that competitive efforts from this factor increase the need to sustain small companies.<sup>16</sup>

In 1972, the nation's 9.4 million small businesses, 96.4 percent of all business firms, accounted for \$1.2 trillion dollars in business receipts, or 52.6 percent of all receipts.\*<sup>17</sup> In the same year, 416,000 small manufacturers, 95.4 percent of all manufacturing firms, accounted for 43.6 percent of all manufacturing revenues. This group of firms, 4.4 percent of all small firms, contributed the largest share of small business receipts: 30 percent, or \$368.6 billion.<sup>18</sup>

As of 1971, the Internal Revenue Service (IRS) estimated that small manufacturing corporations offered the best average return on sales (.034) and the second best average return profit (\$13,910) of all small corporations (see Table I-1). I should be noted, however, that the IRS data represents small firms which are incorporated (10 percent of all firms) and, therefore, may not represent the entire small business

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\* Excluding the construction industry where small firms account for three-fourths of the total revenue.

<sup>16</sup>Ibid, reference #2, p. XIII.

<sup>17</sup>Assembly Office of Research, California Legislature. Small and Minority Business in California Performance and Prospects, Sacramento: Reproduced by National Technical Information Service, 1977, p. 23.

<sup>18</sup>Ibid, p. 24-25.

**TABLE I-1. AVERAGE RECEIPTS, PROFITS AND RETURN ON SALES FOR SMALL BUSINESS CORPORATIONS IN SELECTED INDUSTRIAL CATEGORIES IN 1971**

<b>SMALL BUSINESS CORPORATIONS</b>			
<b>Returns with and without Net Income</b>			
<b>Industry Category</b>	<b>Average Receipts Per Firm (1000's \$)</b>	<b>Average Profits Per Firm (1000's \$)</b>	<b>Average Return on Sales (1000's \$)</b>
All Industries	304.46	8.24	0.030
Contract Construction	374.40	10.80	0.030
Manufacturing	410.38	13.91	0.034
Wholesale Trade	636.43	16.48	0.026
Retail Trade	371.42	7.34	0.020
Food Stores	660.97	7.43	0.011
Auto Dealers	821.07	10.79	0.013
Financial Insurance & Real Estate	64.60	7.68	0.119
Services	145.24	3.15	0.022
<b>Returns with Net Income</b>			
All Industries	399.65	20.72	0.052
Contract Construction	475.21	23.35	0.049
Manufacturing	536.48	31.19	0.058
Wholesale Trade	794.67	28.31	0.036
Retail Trade	459.70	16.09	0.035
Food Stores	762.34	16.31	0.021
Auto Dealers	1051.83	21.65	0.021
Financial Insurance & Real Estate	90.47	18.02	0.199
Service	184.51	15.45	0.083

United States, Internal Revenue Service, Statistics of Income - 1971, Business Income Tax Returns (Washington, D.C.: U.S. Government Printing Office, 1975).



population. (Approximately 85 percent of all small firms are sole proprietorships, and about 5 percent are partnerships with an average of three partners.)<sup>19</sup>

The second largest share of small business receipts was generated by the more than two million small retail establishments (25 percent of the small business population) with 27 percent, or \$337.8 billion.<sup>20</sup>

Evidence of small business contributions to employment was revealed in a study conducted for the Commerce Technical Advisory Board. During the years from 1969 to 1974:

. . . employment increased at an annual rate of only 0.6 percent in established large mature companies, at a rate of 4.3 percent in established but innovative companies, and at a rate of 40.7 percent in young high technology companies . . . Adding new products to the economy . . . stimulat[ing] demand and investment . . . permitt[ing] noninflationary growth in overall demand and offer[ing] escape from the dilemmas of continuing stagflation.<sup>21</sup>

INC, a new magazine devoted to small business, recently published an article with similar data: "From 1969 to 1976, the top 1,000 companies in the United States did not increase their employment. Yet, in the same years, 6 million jobs were added to the economy by small business, "having 66 times the effect of all big business."<sup>22</sup> In 1977, 52 percent

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<sup>19</sup>Ibid, p. 31.

<sup>20</sup>Ibid, reference #17

<sup>21</sup>Ibid, reference #11, p. 4

<sup>22</sup>No author listed. "Speaking Out," INC (January 1979)

of all private employment was attributed to small firms and 43 percent of all U.S. business output.<sup>23</sup> Last year, the U.S. Chamber of Commerce estimated that small business employs 100 million persons,<sup>24</sup> or about two-thirds of all private sector workers in the country.<sup>25</sup>

### Small Business Problems

Despite their role in producing new jobs, and other contributions, small businesses continue to operate under adverse conditions created by problems that have been the subject of debate for many years. A majority of these problems are exacerbated by periods of inflation and recession.

In its Annual Report for Fiscal Year 1979, the SBA stated that there is very little hard data available on the present status of small business because there is no immediate and up-to-date source of information. Recently released Internal Revenue Service data only cover the year 1976 and the most recent complete Economic Census data are for the year 1972. Only preliminary results have been released for the Economic Census of 1977. However, the SBA reported that by looking at the trends for the economy as a whole, the initial evidence implies that:

. . . the amplitude of the cyclical swing for small business is larger than for the economy as a whole; what happens to the small business economy happens more quickly [and the] fluctuations for the small business sector tend to lead the economy as a whole.<sup>26</sup>

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<sup>23</sup>Ibid, reference #2, p. 10

<sup>24</sup>Ibid, reference #1.

<sup>25</sup>Committee on Small Business. House of Representatives, Future of Small Business in America, Washington, D.C.: U.S. Government Printing Office, 1979, p. 7.

<sup>26</sup>U.S. SBA. U.S. Small Business Administration Annual Report FY 1979, Volume 1 (#045-000-0017-9), Washington, D.C.: U.S. Government Printing Office, 1980, p. 3.

In 1975, Business Week published an article that summarized economic conditions which are particularly harsh to small business, conditions which are occurring again in 1980.

After months of devastating inflation and recession, many of the nation's smaller entrepreneurs are fighting for survival. Squeezed by tight money, rising costs, depressed markets, and uncertain supply sources, they find it tougher to cope with economic adversity than larger, more financially robust competitors. Their problems are compounded by growing government intervention, product safety regulations, new occupational safety rules, environmental restrictions, and increased minimum wages pose costly challenges that are more difficult for the small businessman. Just as significant, the harsh economic climate has created unprecedented barriers for new entrepreneurs eager to enter the marketplace.<sup>27</sup>

Inflation has been the number one problem facing the nation and according to the SBA particularly so for small business.<sup>28</sup> Similarly, Neal Smith, chairman of the Commission on Small Business, stated in his report to Congress that, "While big and small businesses have both been burdened by inflation, the weight of the burden on small business is far greater because of its limited means for absorbing the impact of ever-increasing costs and price . . . [and] small business is often the casualty of the very policies that have been used to combat inflation."<sup>29</sup>

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<sup>27</sup>McAubrey, Robert, "Small Business the Maddening Struggle," Business Week (June 30, 1975), p. 96.

<sup>28</sup>Ibid, reference #26, p. 4.

<sup>29</sup>Ibid, reference #25, p. 30.

Even under normal economic conditions, small businesses face disadvantages. The SBA contends that because small business owners enter more competitive areas where entry costs are lower, their operating costs are often set by outside forces: wages by labor unions, energy costs by OPEC, and prices by larger firms. During periods of inflation, these cost-price difficulties reduce profits and cash flow, and make it more difficult for small business to attain loans.<sup>30</sup>

Rising costs for energy also have a greater effect on small business than larger firms. The SBA Annual Report for FY 1979 contains data prepared by the National Federation of Independent Businesses. These data show that, " . . . an average small business with sales of \$50,000 pays about four times as much per dollar of output for energy as a firm with more than \$1 million in sales."<sup>31</sup>

Small business managers also have a number of problems in satisfying government regulations and reporting requirements. The effort and expense required to fill out reporting forms is especially difficult for the small business which usually lacks the staff, funds, and information systems normally available to larger firms which have relatively lower costs due to economies of scale in paperwork.<sup>32</sup>

A special report prepared by small business members of the Industrial Advisory Committee contains recommendations for changes in regulation policy. The report, which was presented to the Secretary of

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<sup>30</sup>Ibid, reference #27, p. 5.

<sup>31</sup>Ibid, p. 8.

<sup>32</sup>Ibid, p. 12.

Commerce in 1979, is based on the belief that the burden of compliance could be substantially reduced for small businesses, and in many cases, eliminated without changing the goals of many regulations. In support of this belief they state that:

It is virtually impossible for the struggling innovator to comply with the never ending forms, mandated reports, applications, investigations, inspections, permits, licenses, standards, variances, checklists, guidelines, plans, study sessions, public meetings, rule-makings, non-rule makings, hearings, non-hearings, burdens of proof, and appeals, etc., to accommodate the rapidly growing enforcement budgets at all levels of government 'to make businesses comply'.<sup>33</sup>

The SBA reported that each year 200 to 300 new regulations are promulgated and about 3,000 major changes to existing regulations are instituted by the federal government. Since its inception in 1977, the SBA's office of Interagency Policy Affairs has identified fifty of these regulations as having a significant effect on small business.<sup>34</sup>

It is argued that some regulation "has been necessary, especially in the case of safety and emissions hardware, because these are innovations that don't normally 'sell' in the consumer market," other regulations are "unnecessary because [they have] been based on poor data or [are inflationary]."<sup>35</sup>

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<sup>33</sup>Industrial Advisory Committee. "The Effects of Domestic Policies of the Federal Government upon Innovation by Small Businesses," Small Business & Innovation, Washington, D.C.: Office of the Chief Counsel for Advocacy, U.S. Small Business Administration, May 1979, p. 17.

<sup>34</sup>Ibid, reference 32.

<sup>35</sup>Rubenstein, A.H. and J.E. Ettie. "Innovation Among Suppliers to Automobile Manufacturers: An Exploratory Study of Barriers And Facilitators, "R & D Management" (September 1979), p. 65.

Taxes, another form of regulation, may be more of a burden for small businesses because they are "largely dependent upon internal capital sources."<sup>36</sup> In his report prepared for the SBA, Michael Sampson lists five categories of problems the tax system has caused which make it more difficult for the small business person to:

1. Retain capital in his business for its operating needs and expansion;
2. Understand and comply with its complexities;
3. Obtain necessary long-term and equity capital;
4. Maintain the independence of his business as a viable economic entity; and
5. Provide financial security for himself and his family.<sup>37</sup>

Baumback and Lawyer add to the list of difficulties encountered by the small business person relating to capital and its formation: (1) obtaining funds at the same rates paid by large firms, and (2) saving and maintaining adequate financial reserves. Capital costs are higher for the small business person because loan processing costs are the same for small or large-scale financing, but their cost relative to the loan value is greater for small loans than for large loans, and interest rates are higher because the failure rate of small firms poses a greater risk for the lending institution.<sup>38</sup>

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<sup>36</sup>Ibid, reference #2, p. 5.

<sup>37</sup>Ibid, reference #9, pp. 15, 16.

<sup>38</sup>Ibid, reference #2, p. 24.

A 1976 editorial in Fortune magazine included several theories regarding capital availability. One theory concluded that there is always talk of capital shortage during periods of inflation. Another theory concluded that all capital needs cannot be met and that only those who have the greatest need and can afford to pay for it, will have capital available. The article also included New York Stock Exchange projections of capital need through 1985. Only \$4 trillion is expected to be available to meet a need of \$4.7 trillion, leaving a \$700 billion shortage.<sup>39</sup>

In 1973, during another period of inflation and capital shortage, Albert Kelly, dean of the School of Management of Boston College, authored a paper in which he discussed another form of finance--venture capital. Kelly suggested that there is "more than an ample supply of venture capital for small enterprises and new enterprises . . . billions of dollars await talented people with good business ideas . . . but . . . sources are often difficult to uncover."<sup>40</sup>

Three elements that Kelly considered pertinent to starting a new venture are "technology, management, and capital--good management finds and recognizes technology, and capital comes to good management."<sup>41</sup>

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<sup>39</sup>No author listed. "The Big Question About Industrial Capacity," Fortune (January 1976), p. 105.

<sup>40</sup>Kelley, Albert J. "Venture Management and Capital," Technology Review (March/April 1973), p. 36.

<sup>41</sup>Ibid, p. 35.

Qualities he believes are important to attract a venture capitalist are:

- o A product, or service with a large market potential.
- o Patent protection of skill and know-how, or assurance that no one else has a patent.
- o An experienced, talented management team.
- o A company which, when successful, can and wants to go public.
- o An industry likely to be above average in price-earnings ratio if publicly owned.

He adds that venture-capital sponsored companies do not fail as often as small businesses in general, because of these special qualities and because management assistance is usually provided by the venture capitalist. However, 95 to 97 percent of all proposals submitted to a typical venture capital company are rejected after a brief discussion and only about 0.5 percent are eventually financed after careful examination.<sup>42</sup>

While venture capital funding offers opportunity for a few selected small business entrepreneurs, it offers little hope for the majority of small businesses.

Regarding other forms of funding, the SBA reported that it appears that, "more of the total debt of small businesses comes from commercial firms . . . is short term credit . . . is borrowed at rates that continue to go up [and applications are more frequent]."<sup>43</sup>

In comparison to large firms, the smallest manufacturing firm has a debt/equity ratio of 2.99 compared to the largest size firm class with

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<sup>42</sup>Ibid, reference # 40.

<sup>43</sup>Ibid, reference #26, p. 6.



.57, over five times greater than the largest enterprise. In the construction industry, the smaller firm has nearly four times the debt/equity of the largest firm. In retail and wholesale industries the ratio is 3.5 times as large. A small business will give debt, including bank credit, a higher priority than would a large firm.<sup>44</sup>

### Small Business Failures

These problems and others have proven to be too much for some small businesses and they have not been able to survive. Reliable statistics on the start and failure rate of small businesses only are not available; however, the SBA estimates that 400,000 small firms go out of business each year for many reasons, including an unknown number which fail. Dun and Bradstreet, Inc. corroborates this figure to some degree: each year "several hundred thousand firms are started, almost an equal number are discontinued, and even more transfer ownership and control."<sup>45</sup> Dun & Bradstreet's failure statistics are not broken down by company size, so it is essential to remember that in all industries except mining, transportation and utilities, small firms comprise approximately 97 percent of all firms (see Table I-2).

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<sup>44</sup>Ibid.

<sup>45</sup>Business Economics Division, Dun & Bradstreet, Inc. The Business Failure Record, New York, New York: Dun & Bradstreet, 1977, p. 3.

TABLE I-2. COMPOSITION OF SELECTED INDUSTRIAL  
CATEGORIES BY SIZE OF FIRM\*

INDUSTRIAL CATEGORY	% SMALL BUSINESS	% LARGE BUSINESS
Construction	99.2	0.8
Manufacturing	95.4	4.6
Transportation, Utilities	88.0	12.0
Wholesale Trade	98.1	1.9
Retail Trade	99.0	1.0
Finance, Insurance and Real Estate	99.8	0.2
Selected Services	94.3	5.7
Agriculture, Forestry and Fisheries	93.8	6.2
Mining	88.3	11.7
All Industry	96.7	3.3

Alfred Malabre, Jr., a reporter for The Wall Street Journal, recently reported business failure trends and provided data to support the contention that in general, failure rates per 10,000 firms have decreased over the years and that failures during recent periods of inflation have been considerably less than those recorded during past heavy growth periods.<sup>46</sup> He observed that business failures were greater during the 1960's--"the first years of the longest economic expansion in

\*Source: Small Enterprise in the Economy, Vol. 1, No. 4, December 1975.

<sup>46</sup>Malabre, Jr., Alfred L. "Despite a Worrisome Rise, Far Fewer Firms Fall Nowadays Than Before Inflation Soared" The Wall Street Journal, Weds., March 12, 1980, p. 46.

the country's history," when consumer prices increased by only 1 percent or less a year. In 1961, 64 firms per 10,000 failed for a total of 17,075, the highest rate since 1939. In 1965, 53 firms per 10,000 failed; in 1970, the figure was 44 per 10,000 and in 1978 just 24 per 10,000. A slight upturn to 30 per 10,000 was predicted for 1979 with approximately 14,000 failures total.

The graph provided by Malabre (see Figure I-1) shows the failure rates per 10,000 firms from the years 1960 to 1978.

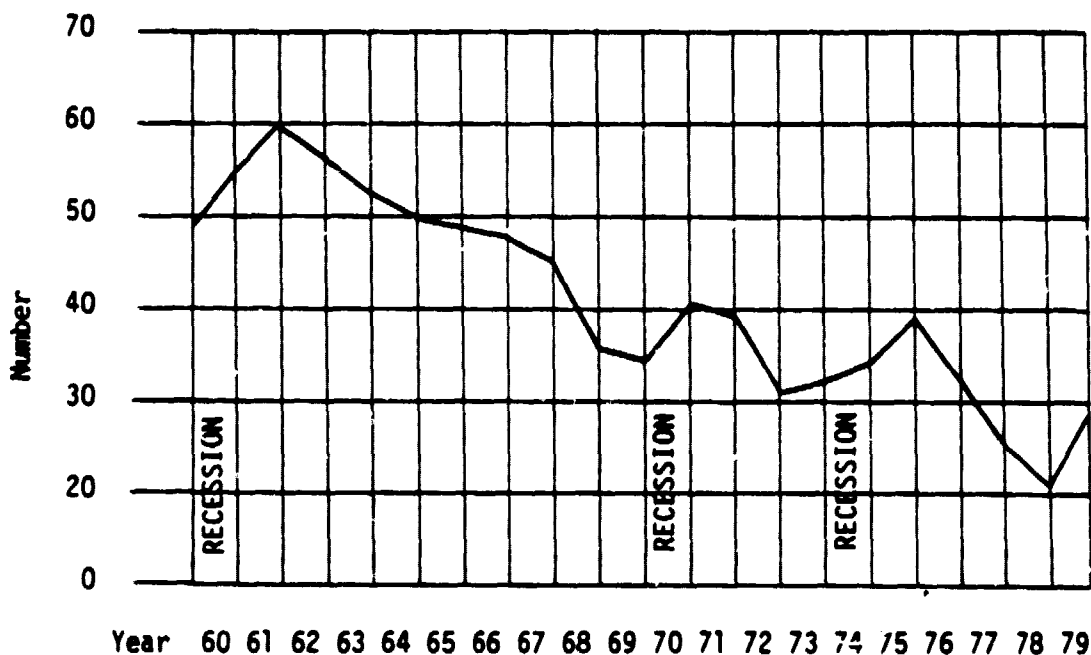


FIGURE I-1. FAILURES PER 10,000 FIRMS

According to economists, there are several unexpected reasons for the reduced failure rate over the long term including "inflation, . . . depressed share prices . . . and sharply rising federal aid to private enterprise." Malabre included a statement by Paul Markowski, a New York economic consultant: "As unpopular as inflation has supposedly become, the truth is that the big rise in prices has helped keep a lot of poorly run companies above water." In the same vein, Malabre repeated comments by Alan Greenspan, chief economic advisor to Presidents Nixon and Ford: "Clearly, [inflation is] the number one reason that a higher percentage of businesses have managed to survive in recent years . . . Inflation acts to reduce competitiveness and protect inefficiency . . . fosters a climate where badly managed companies can more easily put through price increases while continuing to sell goods and services of inferior quality."

Malabre added that some unhealthy firms have been saved by healthier corporations which buy shares of the poorly managed companies at "prices far below what it would cost to replace the underlying assets."

He further contends that the recent upturn in failures may be partially due to the early symptoms of the predicted recession--noting that failures tend to rise during these periods and continue for a short time thereafter. An additional reason cited for the increases in failures, may be a recent change in the bankruptcy laws which "allow some debtors to be forced into bankruptcy proceedings more readily."

In 1972, the national failure rate was about 38 per 10,000 firms.<sup>47</sup> Among manufacturing firms, producers of transportation equipment had the

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<sup>47</sup>Ibid, reference #45, p. 2.

highest failure rate with 119 per 10,000. The next highest rate was recorded by furniture manufacturers (98.8 percent small firms) with 113 failures per 10,000. The stone-clay-glass industry (98.9 percent small firms, and considered a low-technology sector) exhibited the lowest failure rate of all manufacturing industries, 20 per 10,000 concerns. In 1976, the national failure rate decreased to 35 per 10,000 concerns, with transportation equipment manufacturers at 77 per 10,000 firms and furniture makers at 85 per 10,000 trading their positions.<sup>48</sup>

Firms in retail trade, manufacturing, and construction--industries predominantly composed of small firms--account for approximately 75 percent of all business failures. In a given year, approximately 43 percent of all business failures will occur in retail trade, while manufacturing and construction firms will account for another 32 percent. Table I-3 shows the share of business failures per industry for the years 1972, 1974 and 1976.<sup>49</sup>

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<sup>48</sup>Ibid, pp. 8, 9.

<sup>49</sup>Ibid.

TABLE I-3. PROPORTIONAL SHARE OF BUSINESS  
FAILURE BY INDUSTRIAL CATEGORY  
1972, 1974, 1976\*

INDUSTRIAL CATEGORY	1972	Percent by year 1974	1976
Mining	.5	.1	.3
Manufacturing	16.0	15.6	13.7
Wholesale Trade	10.1	9.7	10.7
Retail Trade	45.9	42.7	43.0
Construction	14.4	18.5	18.4
Commercial Services	13.1	13.3	13.8
N =	9,566	9,915	9,638

Failures in the mining and manufacturing sector entail the greatest repercussions. In 1972, the average liability of a failed manufacturing concern totaled almost \$493,000; by 1976, the average liability had increased to \$767,700. Taking inflation into account, there was a real increase of 16 percent.<sup>50</sup> The liabilities of failed firms in individual industries can be seen in Table I-4.

\*Source: The Business Failure Record, 1976, pp. 8. 9.

<sup>50</sup>Ibid, reference #45.

**TABLE I-4. AVERAGE LIABILITY OF FAILED CONCERNS  
BY INDUSTRIAL CATEGORY  
1972, 1974, 1976\***

INDUSTRIAL CATEGORY	Average Liability (000's)		
	1972	1974	1976
Mining	\$270.6	\$1,122.4	\$2,863.8
Manufacturing	492.8	532.1	767.7
Wholesale Trade	258.6	285.1	402.4
Retail Trade	126.9	252.6	134.5
Construction	140.7	286.1	242.2
Commercial Services	207.2	263.7	368.2

In 1976, Dun & Bradstreet examined the reasons for failure in 9,628 businesses and reported that "managerial inexperience and ineptitude" was the underlying cause of nine out of ten casualties. Dun & Bradstreet categorized these firms according to conditions which contributed most to each firm's failure as shown in Table I-5 (subsumed under the "management inefficiency and ineptitude" headings). Two points on the table deserve special notice: (1) "competitive weakness" accounted for a smaller percentage of difficulties in manufacturing firms than in other types of firms; and (2) manufacturing firms seem to fare worse than other types of firms in the "heavy operating expense" category.

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\*Source: The Business Failure Record, 1976, pp. 8, 9.

TABLE I-5. OPERATING DIFFICULTIES WHICH CONTRIBUTED  
TO FIRM'S FAILURE\*

TYPES OF DIFFICULTIES	MANUFACTURERS	WHOLESALERS	RETAILERS	CONSTRUCTION	COMM'L SERVICES	ALL
Inadequate Sales	55.2%	53.9%	50.5%	43.2%	48.8%	49.9%
Heavy Opera- ting Expenses	15.2	11.4	11.6	15.9	12.6	13.0
Receivable Difficulties	12.7	15.3	3.0	15.1	5.6	8.3
Inventory Difficulties	6.4	11.9	11.9	0.8	1.7	7.7
Excessive Fixed Assets	4.6	2.2	2.7	2.6	5.2	3.2
Poor Location	0.6	0.3	5.3	0.6	1.7	2.7
Competitive Weakness	21.0	23.4	24.9	30.7	25.3	25.3
Other	1.6	1.8	1.1	0.8	0.8	1.1
N = 9,628						

Note: percentages may add up to more than 100% because some failures are attributed to difficulties in more than one category.

Dun & Bradstreet reported that these two factors plus "excessive fixed assets" are in general, less frequent causes of failure now than in 1961; the "inadequate sales" factor is cited more frequently.<sup>51</sup>

\*Source: The Business Failure Record, 1976, pp. 12, 13.

<sup>51</sup>Ibid, p. 13.



Baumbach and Lawyer state that the first year of operations has the highest mortality rate and the odds for survival increase each year. They report that one of three retail stores do not survive the first year and two out of three close within six years; one of five manufacturers and wholesalers go out of business in the first year and within nine years two out of three will end operations.

They add, that in the opinion of creditors, 98 percent of the business failures reported by Dun & Bradstreet in 1976 were caused by underlying factors of ineffective management. Again, from the creditor's point of view:

. . . in 44 percent of these cases . . . the businesses should never have been started in the first place because of owner incompetence. In the remaining instances, poor management was attributed to the owner's lack of experience in the business; lack of management experience or "know-how"; or unbalanced management training or experience, i.e., knowledge or experience not well rounded in sales, finance, purchasing and production.<sup>52</sup>

Carroll Kroeger, in a 1974 paper, contended that "limitations to growth of the small firm are directly related to the degree of management capability. Success or failure is determined by the level of managerial competence."<sup>53</sup> In support of this contention, he presented the "life-cycle growth pattern" as illustrated in Figure I-2. Five stages of growth in the life-cycle of a business are identified and paired with appropriate management roles.

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<sup>52</sup>Ibid, reference #2, p. 20.

<sup>53</sup>Kroeger, Carroll V. "Managerial Development in the Small Firm," California Management Review, Volume XVII, No. 1 (Fall 1974), p. 41.

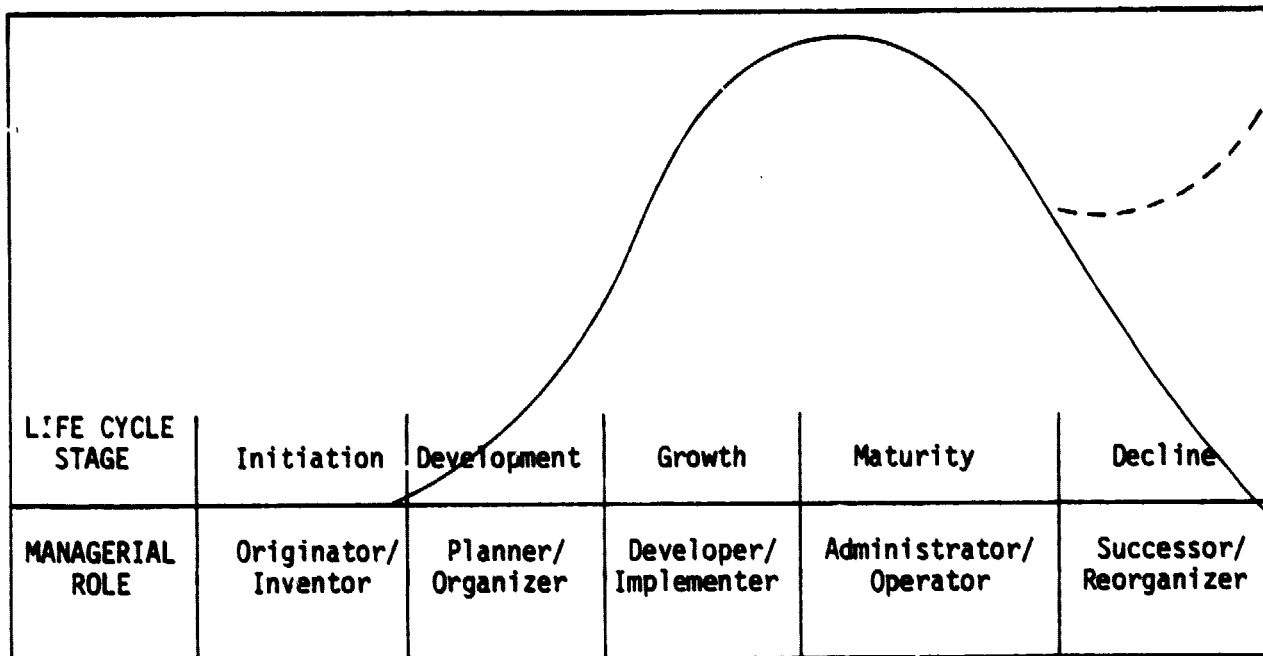


FIGURE I-2. MANAGERIAL ROLES RELATED TO THE LIFE CYCLE OF THE FIRM\*

Kroeger also included a brief outline of the five stages and managerial skills required at each level (see Table I-6).

Stressing the importance of management development for operators of small or large firms, Kroeger stated that at some time these managers will need to "assume new roles and perform activities for which they have

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\*Source: Carroll V. Kroeger. "Managerial Development in the Small Firm," California Management Review, p. 42.

TABLE I-6. RELATIONSHIP OF BASIC MANAGERIAL SKILL  
AND CAPABILITY TO THE STAGES OF THE LIFE CYCLE

LIFE CYCLE STAGE	MANAGERIAL ROLE	MANAGERIAL QUALITIES	BASIC SKILL REQUIREMENT	PRIMARY FUNCTIONAL EMPHASIS
1. Initiation	Originator-Inventor	Innovation, Independence, Self-Confidence, Risk-taking & Vision.	Perceptual & Conceptual	Technology
2. Development	Planner-Organizer	Investigation, Planning, Evaluation, Judging, Organizing, Negotiation & Decision-making.	Analytical, External-Behavioral Interpersonal Relations	Finance
3. Growth	Developer-Implementer	Leadership, Delegation, Motivation, Supervision, Achievement & Decision-making.	Budgeting, Scheduling, Controlling, Internal Intergroup Relations	Production Marketing
4. Maturity	Administrator-Operator	Maintenance, Coordinating, Efficiency Seeker.	Internal Intergroup Relations	Marketing
5. Decline	Successor-Reorganizer	Type A-Innovative Change Agent, Risk Taking, Vision, Strategic planner  Type B-Efficiency Seeking, Change Agent	Perceptual & Conceptual, External Interpersonal Relations  Budgeting, Controlling Internal Intergroup Relations	Technology

little or no background . . . every manager regardless of background, will need to update his training to fill future managerial roles."<sup>54</sup>

Peter Drucker, in his article for The Wall Street Journal, emphasized points similar to Kroeger's about management capabilities and their effects. At the same time, he acknowledged the tremendous demands that growth makes on management energy. Drucker stressed the need for a business to anticipate future information needs in order to prevent a growth crisis-- information needs that go beyond internal accounting data, including information about what goes on outside of the business and in the marketplace.

He describes a small-growth business as one that usually starts out:

. . . typically as the brain-child of one or two [people]  
. . . generally entrepreneurs with vision, drive, ability  
and courage . . . endowed with strengths . . . and weak-  
nesses . . . high product imagination, great capacity for  
product development, and ability in promotion . . . with  
a fast growing, highly successful small company [based on  
this] ability . . . and if [the owner] is conscientious,  
he will almost certainly kill [it] . . . by spending so  
much time on what he cannot do well he will neglect what  
he can do well. [In a few years the company will reach a  
growth crisis and] usually goes out of existence, having  
lost the original advantages its founder gave it.

Another type of manager profiled by Drucker is one who concentrates on product design and is unconcerned about the other aspects of running the business such as marketing and production. In three to five years, Drucker predicts this business will reach the same growth crisis.<sup>55</sup>

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<sup>54</sup>Ibid, reference #54, p. 43.

<sup>55</sup>Drucker, Peter F. "Helping Small Businesses Cope," The Wall Street Journal, April 21, 1977.

Most of the problems previously mentioned exist for small business in any type of economic situation, but recent double-digit inflation and recession have caused more attention to be focused on finding solutions. Small businesses have immediate needs which, if fulfilled, would benefit the whole economy. An editorial that recently appeared in INC magazine included the statement:

Many economists in government and industry agree that the best way to combat inflation is to increase productivity, to promote technological innovation, and to generate capital formation. The most efficient way to do all of this is through revitalizing the small business sector of our economy.<sup>56</sup>

Steps have been taken to improve the situation for small business. Federal agencies, elected officials and small business representatives have attempted to develop programs and legislation that aid small business. The SBA, for example, provides training, printed materials, financial assistance and staff consulting to help small business managers with their immediate difficulties. Presently, the SBA is developing a data bank on small business in order to improve its information concerning the small business sector which, in turn, should improve the understanding of small business problems and support the development of better solutions.

The Department of Commerce has special programs to provide management and technical assistance to small business, and the Senate Select Committee on Small Business is also actively involved in the process of helping these firms. The committee has introduced and co-sponsored 47 bills that are presently pending in various committees.

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<sup>56</sup>Hambrecht, William. "Emerging Companies Must Have Access to Public Equity Markets." Speaking Out, INC (August 1979). p. 12.

Neal Smith, chairman of the House of Representatives Committee on Small Business, stated in the committee's 1979 report, "Future of Small Business in America," that,

Unless direct and concerted action is taken now, small business, the mainstay of a truly competitive system, will continue to decline. This decline will have disastrous consequences for the American economy considering the proven contributions of small business to areas such as job creation and innovation.<sup>57</sup>

Small business representatives have also been very active advocates for improved understanding of their problems and in finding various solutions to the problems. Their efforts were documented by the results of the 1980 White House Conference on Small Business. The Conference was mandated by the Small Business Act (1978 revision), and followed a series of 57 hearings held throughout the United States to determine the status of small business, its problems and potential solutions. The hearings were attended by small business representatives, government officials and others. Small business persons played an integral role in formulating the conference agenda.

The hearing results are summarized in a report prepared by the Senate Select Committee on Small Business. The report addresses the issues of taxes, capital and credit needs, technology transfer and innovation, procurement, economic concentration and antitrust, regula-

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<sup>57</sup>Ibid, reference #25, p. 37.

tory and paperwork reduction, energy, rural assistance, international trade, management assistance, education and training, and small business advocacy within the Federal government.<sup>58</sup>

The conference, attended primarily by selected small business representatives, resulted in a list of sixty recommendations on how the federal government can help small business. Fifteen of the recommendations were considered to be of top priority and many relate to problems that have existed for years. The fifteen priority items are listed below (see Appendix A for the complete list):

1. Increase graduation of corporate and individual tax schedules
2. Adopt rules to simplify and accelerate asset depreciation
3. Balance the federal budget
4. Revise estate tax laws
5. Enact sunset review of laws, regulations and agencies
6. Pass existing legislation that encourages small business innovation
7. Enact a tax credit for initial investments in small companies and permit tax-deferred rollover of those investments
8. Reform the social security system
9. Approve creation of the Small Business Participating Debenture . . . to help small business raise capital
10. Beef up the SBA's Office of Advocacy
11. Insure equal access to commercial credit for women in business

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<sup>58</sup>Select Committee on Small Business, United States Senate. Discussion and Comments on the Major Issues Facing Small Business, Washington, D.C.: U.S. Government Printing Office, 1979.

12. Reimburse a small business for costs and damages when the business wins a civil court action brought by a governmental agency
13. Lower the minimum wage for teenagers, seasonal workers, and part-time employees
14. Set mandatory goals for small businesses' share of government procurement
15. Conduct economic impact studies before placing new regulatory requirements on small business.<sup>59</sup>

Pat O'Brien, INC's Washington editor, reported in an article published prior to the White House Conference that, "Washington lobbyists and congressional staff members warn that it's going to take continuing pressure and urging from small business to insure that Carter and Congress act on the recommendations."<sup>60</sup>

A statement by the House Small Business Subcommittee on Antitrust, Consumers and Employment summarizes a current, widespread perception of the small business sector:

The role of small business in our economy is declining at an alarming rate. As the number of small businesses in industries declines and the concentration ratios increase, the continuing viability of small firms is severely threatened . . . by focusing the proper attention on small business problems and by taking the steps necessary for meeting the particular needs of the small business community, the extinction of that community will no longer be a potential reality.<sup>61</sup>

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<sup>59</sup>No author listed. "Small Business Discovery in D.C.: We Have Clout," INC (March 1980), p. 20.

<sup>60</sup>O'Brien, Pat. "The White House Conference on Small Business,-- Uncle is Listening But Will He Hear?", INC (Jan. 1980), p. 70.

<sup>61</sup>Ibid, reference #25, pp. 17 and 19.



## SECTION II. SMALL BUSINESS AND TECHNOLOGY

The "Small Business Innovation Act of 1979" contains the following statement:

Technology innovation is a most important contribution to job creation, increased productivity, competition and economic growth in the United States as well as a valuable counterforce to inflation and our balance of payments deficit . . . Small business is a principal source of major innovations in the Nation when compared with large businesses, universities and government laboratories.<sup>1</sup>

Several studies have shown that small corporations have been responsible for 50 to 74 percent of the most significant U.S. technological innovations.<sup>2</sup> Since the late 1700's and through the 1970's individual and independent inventors and entrepreneurs have been a substantial source of advancements in technology including the introductions of "radically new concepts."<sup>3</sup>

While innovation is difficult to assess directly, productivity, one major result of innovation, can be measured, and the rate of increase in productivity has steadily diminished. From World War II through 1965, the "average annual rate of productivity for a manufacturing worker"

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<sup>1</sup>SBA Advocacy Task Force. "Small Business Innovation Act of 1979, Small Business & Innovation, Washington, D.C.: Office of the Chief Counsel for Advocacy, U.S. Small Business Administration, May 1979, p. 6.

<sup>2</sup>Hlavacek, James D., Brian H. Dovey, and John J. Biondo. "The Small Business Technology to Marketing Power," Harvard Business Review (Jan/Feb 1977) p. 106.

<sup>3</sup>Industrial Advisory Committee. "The Effects of Domestic Policies of the Federal Government upon Innovation by Small Businesses," Small Business & Innovation, Washington, D.C.: Office of the Chief Counsel for Advocacy, U.S. Small Business Administration, May 1979, p. 1.

increased by 4.1 percent. The amount of increase was reduced to 1.6 percent through 1975 and to 1.0 percent in 1978. The predicted rate of increase for 1979 was 0.4 percent--a ten-fold decline for the last fifteen years.<sup>4</sup>

### Innovation Problems

Several factors have led to a reduced number of innovations by all firms in the United States. Myers and Sweezy reported in their Technology Review article that innovations start easily during periods of a sagging economy, and then progress slowly and with difficulty despite effective market research, proper management policies and an ample supply of technology. In contrast, a booming economy stimulates innovation which, in turn generates demand and further innovation.

Even in a prosperous economy industrial innovations frequently fail. Myers and Sweezy described one study that showed, even though the failure rate varies among industries and companies, an average of 58 ideas were discarded for every successful new product developed. Most of these ideas failed at the onset, with only 10 or 12 percent of the ideas ever reaching the development stage.<sup>5</sup>

Lawrence W. Bass, retired vice-president of Arthur D. Little, Inc. reported study results on commercial R & D: "... of 540 ideas initially screened, ninety-two were evaluated in laboratories, seven were reduced to models, and one final product resulted." Equally discouraging figures relating to product development are offered by the SBA. Its

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<sup>4</sup>Ibid, p. 4.

<sup>5</sup>Myers, Sumner and Eldon E. Sweezy. "Why Innovations Fail," Technology Review (Mar/Apr 1978), p. 41.

studies showed that only 2 percent of the proposals originating in twenty large companies reached the development state.

In 1966, Robert Charpie, then Director of Technology at Union Carbide, reported that out of a total of 500 concepts reviewed by the company each year (about 10 per week), perhaps two totally new ideas, or one in two hundred, are acted upon. In addition, Booz, Allen and Hamilton stated that two products fail for every three new products commercialized by the 200 best run companies.<sup>6</sup>

Myers and Sweezy cited other failure examples from their study of a sample of 200 innovations that failed following commercialization. The marketplace posed the greatest risks to many of the innovations studied; uncontrollable market factors led to the failure of 27.5 percent. In addition, limited sales accounted for 16 percent, revealing a weakness in market research efforts; products developed in the public interest prevented the success of 10 percent, and 23.5 percent of the failures were attributed to poor management which caused the products to be either shelved, cancelled or delayed. Competition accounted for 7 percent of the failures and 11.5 percent of the sample was affected by technology--one-quarter of these products were outdone by "another company's superior technical approach that had not been anticipated." Lack of capital prevented the success of 15.5 percent of the innovations with overruns occurring in almost one-third of this group. Overall, half of the failures were due to management and marketing problems and one-third to market factors. Of the total number of products developed, management still considered ninety-two to be worth saving. Of the "good

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<sup>6</sup>Hough, Granville W. Technology Diffusion, Mt. Airy, Maryland: Lomond Systems, Inc., 1975, p. 44.

innovations, 28 percent failed due to management error and 20 percent due to government regulations.<sup>7</sup>

### Capitalization Problems

Other factors having an impact on the amount of innovation by small business were described in a 1979 report by small business people to the Department of Commerce. In their view (not necessarily the view of the Department of Commerce or the SBA) some of the factors that inhibit the innovation process are related to capital, research and development (R & D) and patent rights. The group contends that large firms have a great many advantages, including incentives to innovate, over small firms.

Access to capital is one of the advantages mentioned. Large firms generally are able to raise innovation financing capital from their own cash flow while small firms must depend on outside sources.<sup>8</sup>

In the past, some small firms have been able to obtain capital from individual investors for each stage of the innovation process (seed, start-up and expansion). But now, changes in tax policies favoring retirement funding, oil and gas drilling, agriculture and real estate have made these more attractive to private investors. In addition, retirement funds put into "tax sheltered centralized institutional investment pools are precluded by law from investing in promising local ventures."<sup>9</sup> The following statement by the small business group provides further evidence of the capital shortage experienced by small business:

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<sup>7</sup>Ibid, reference #5, pp. 41-45.

<sup>8</sup>Ibid, reference #3, p. 6.

<sup>9</sup>Ibid, p. 11.

. . . in the seven years from 1969 to 1975, the amount of capital acquired from public markets by small firms with less than \$5 million in net worth, declined from approximately \$1,500 million to approximately \$15 million--a 100 fold decrease--yet capital raised by all corporations in the public security markets increased from \$28 million to \$41 billion in 1975 . . . an increase of approximately 30 percent.<sup>10</sup>

Large corporations also have tax advantages not available to small firms. The profitable large corporation receives an "immediate tax benefit of approximately fifty percent for research and innovation related expenses, and a ten percent tax credit for related capital expenditures." In contrast, these benefits are only available to small firms after the capital intensive first stages when, and if, the new product shows a profit. As a result, the small firm must raise "more than twice the amount of capital for the same innovation as a large corporation." In addition, the tax structure also prevents the small firm from accumulating sufficient retained earnings to finance internal expansion due to the success of the new product.

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<sup>10</sup>Ibid, p. 4.

## R & D Problems

Research and development is another area of concern. Half of the total amount of R & D performed on the national level, as a percentage of the Gross National Product (GNP) is federally funded. This portion has been declining since 1968--nearly 3 percent of the GNP in 1963 and only 2.2 percent in 1978.<sup>11</sup> Space, defense, energy, education, and health and welfare agencies fund over 88 percent of all federal R & D concentrated within a few large industries and firms. R & D performed privately by industry is similarly concentrated. Science Indicators revealed that 85 percent of all U.S. industrial R & D was performed by only six industries (aircraft and missiles, electrical equipment and communication, machinery, motor vehicles and other transportation equipment, chemicals and allied products, and professional and scientific instruments) in 1974; 80 percent by only 200 firms; thirty-one firms performed 60 percent of the total amount of industrial research and only 10 companies accounted for 36 percent.<sup>12</sup> These figures refer to prime contracts, however, and do not reflect the fact that prime contractors usually manage many subcontracts with small business--a management technique that can be more efficient than having a large number of small contractors reporting directly to a personnel-limited government program office.

Despite the fact that small firms conduct a little more than three percent of the R & D in the U.S., in the twenty years from 1953 to 1973,

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<sup>11</sup>National Science Board, National Science Foundation. Science Indicators 1978, Washington, D.C.: U.S. Government Printing Office, 1979, p. 140.

<sup>12</sup>Ibid, reference #3, p. 18.

small business contributed "twenty-four times the number of innovations per dollar of R & D as did large firms," according to Science Indicators.<sup>13</sup>

In 1967, Robert McNamara, then Secretary of Defense, explained federal justifications for the low percentage of R & D allocated to small business at that time:

. . . . our R & D emphasis and dollars are mainly in development of aircraft, missile, space and electronic systems with 81.5 percent of our dollars going to this type of R & D program. Small business firms have only limited potential for this type of effort. They lack the technical and financial resources, scientific and engineering staffs, laboratories, test facilities, and the like to be systems development prime contractors. Small business does, however, participate in these programs on a subcontracting basis.<sup>14</sup>

Legislative action to increase the small business share of federal R & D has already been taken. The "Small Business Innovation Act of 1979" stipulates additional increases in prime R & D contracts set-aside for small business by at least one percent per year of each federal department or agency's total R & D budget. There are associated problems, however, in staffing to manage a large increase in prime contracts and in obtaining the complex hardware and/or services to satisfy some department and agency requirements. The Act also proposes a competitive solicitation program for small business innovation research similar to the National Science Foundation's program. All federal departments and agencies with an R & D budget of \$100 million or more would be included

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<sup>13</sup>Ibid, reference #3, p. 18 and 19.

<sup>14</sup>Hargrave, Carolyn Hooper. "Distribution of Federal Expenditures for Research and Development: Implications for Small Business," Federal Bar Journal, Volume 32 (Spring/Summer 1973), p. 187.

and each would be required to commit one percent or more of its entire R & D budget to this program.<sup>15</sup>

Government agencies have already increased the small business share of R & D awards as required by previous legislation. For example, in 1978 the Department of Defense awarded small business contracts worth \$19.2 billion (including small business set-asides), equal to 24.4 percent of their total budget of \$78.8 billion (the totals include some amendments to ongoing contracts).<sup>16</sup> The 1980 NASA Authorization includes figures relating to small business participation in NASA procurement programs:

During Fiscal Year 1978, NASA direct awards to small business firms amounted to \$281.5 million . . . 10 percent of the total awards to business firms . . . which resulted from 85 thousand procurement actions or 62 percent of the total number of actions placed with business firms . . . the total amount of new awards in which small business could have participated was \$739 million, consisting of \$633 million new awards of \$10,000 and over and \$106 million awards of less than \$10,000. Of this \$739 million small business received \$185 million or 25 percent.<sup>17</sup>

Not all firms are anxious to participate in federal procurement programs, however. A small R & D firm interviewed during a study of small businesses in Region VIII made the following comment:

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<sup>15</sup>Ibid, reference #1, p. 7.

<sup>16</sup>Heintzelman, Harry, Procurement Analyst, Prime Contractor Division, Small Business Administration, Washington: telephone conversation March 1, 1980.

<sup>17</sup>National Aeronautics and Space Administration. 1980 NASA Authorization, Hearing before the Committee on Technology, U.S. House of Representatives, Ninety-Sixth Congress, First Session on H.R. 1786, Washington: U.S. Government Printing Office, 1979, p. 826.



It is getting to the point where no one in the industry wants government contracts . . . we will get a hundred pages of regulations and maybe four or five pages of technical parts which make our job very complex and difficult.<sup>18</sup>

The group of small business people are also concerned with present patent policies. In their view, small businesses do not receive equal treatment. They stated that patent rights awarded freely to large firms, are often difficult to obtain by small firms under similar circumstances. And frequently, in order to receive a contract, small businesses must assign the patent rights to the government for use by others, regardless of whether the rights were developed at the small business expense. These policies are considered further deterrents to small business innovation.<sup>19</sup>

In summary, small business people stated that as a result of these adversities, many small innovative firms, "in order to meet expansion needs, to obtain federal regulatory permits, to sell a new product to the government, or to defend its patents, [find] . . . it is necessary . . . to sell out to a large firm with greater resources. When this occurs, the research and development budgets are often cut and the innovative entrepreneurs leave the firm. A creative, independent organization is changed into a static dependent one."<sup>20</sup>

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<sup>18</sup>Nelson, Roger H. Edwin, Tiffany Hawks and Ali Rexa Malekzadeh. The Role of Small Business in Research and Development Technological Change and Innovation in Region VIII," The Regional Environment for Small Business Entrepreneurship in Region VIII, Denver, Colorado: Denver Research Institute for the Office of Economic Research, U.S. SBA, 1979, p. 89.

<sup>19</sup>Ibid, reference #3, p. 22.

<sup>20</sup>Ibid, p. 8.

## Market Share Problems

In 1967, Michael Shanks described the emergence of a "dual economy" in the British industry, and he noted that this phenomenon "seems to be happening in most industrialized countries." He described the dual economy as the evolution of:

. . . on the one hand a highly advanced sector of mainly large firms employing all types of modern technology (both hardware and software); on the other a wide fringe of mainly small firms, operating at a lower level of sophistication, unable to profit from the discoveries of technology, depressing the level of the whole economy.<sup>21</sup>

In the U.S. manufacturing sector, the dual economy may have arrived in some industries. By 1972, in approximately 86 percent of all manufacturing industries, the 8 largest companies in each industry accounted for over 30 percent of the respective industry's shipments. In over half of all manufacturing industries, the 50 largest companies in each industry accounted for 80 percent of the respective industry's shipments (see Table II-1).

Small manufacturers have been slowly losing ground to large companies which operate increasingly large scale systems of small, strategically located manufacturing plants. In 1958, a typical manufacturing firm with a total employee force of 2,500 to 4,999 employees operated approximately 27 manufacturing establishments. By 1972, this number had increased by 30 percent to 35. Similarly, firms of over 10,000 employees increased the average number of establishments by 26 percent, from 280 in 1958 to 352 in 1972 (see Table II-2).

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<sup>21</sup>Shanks, Michael. The Innovators, Baltimore, Maryland: Penguin, 1967, p. 214.

TABLE II-1. NUMBER OF INDUSTRIES IN WHICH THE LARGEST 8,  
20 AND 50 COMPANIES ACCOUNT FOR 30%, 50% AND  
80% OF INDUSTRIES' TOTAL SHIPMENTS\*

		8 LARGEST COMPANIES	20 LARGEST COMPANIES	50 LARGEST COMPANIES
Percent of industry's total shipments accounted for by large companies	30%	379 industries <sup>1</sup>	355 industries <sup>2</sup>	250 industries <sup>3</sup>
	50%			
	80%			

Total number of industries = 450

<sup>1,2,3</sup>Number of industries for which data was not available: 8  
largest companies-14; 20 largest companies-40; 50 largest  
companies-53.

Between the years 1958 and 1972, excluding Industry Group 37  
(production of aircraft, motor vehicles, locomotives, boats, missiles  
and space vehicles--high technology industries where large firms dominate)  
the number of small manufacturers decreased by 2.4 percent, and their  
share of manufacturing sales and receipts decreased by 24.7 percent (see  
Table II-3).

\*Source: data compiled from the 1972 Census of Manufacturers, Concen-  
tration Ratios in Manufacturing, Table 5. Share of Value Shipments  
Accounted for by the 4, 8, 20 and 50 Largest Companies in Each Manufac-  
turing Industry: 1972 and earlier years, p. SR2-6 to SR2-46.

TABLE II-2. ESTABLISHMENTS-TO-COMPANY RATIO BY EMPLOYMENT-SIZE CLASS OF COMPANY: 1958, 1972

	SMALL MANUFACTURERS				LARGE MANUFACTURERS				
	less than 20 employees	20-99	100-249	250-499	500-999	1,000- 2,499	2,500- 4,999	5,000- 9,999	10,000 or more
Number of 1958 Manufac- turing Establish- ments	1.006	1.105	1.629	2.897	5.234	12.901	27.624	61.418	279.839
	1.005	1.100	1.760	3.399	6.999	15.828	35.582	71.451	352.573

Source: data compiled from 1958 Enterprise Statistics, Part C, General Report, U.S. Census Table 9, page 123; and from 1972 Enterprise Statistics, Table 5, U.S. Department of Commerce, Bureau of the Census.

TABLE II-3. CHANGES IN MANUFACTURING SECTOR EXCLUDING MAJOR INDUSTRY GROUP  
37-TRANSPORTATION EQUIPMENT<sup>2</sup>-NUMBER OF SMALL/LARGE FIRMS, PERCENTAGE  
OF MANUFACTURING SALES AND RECEIPTS, 1958 AND 1972

	1958		1972		% CHANGE 1958-1972	
	NUMBER OF FIRMS	% MANUFACTUR- ING SALES AND RECEIPTS	NUMBER OF FIRMS	% MANUFACTUR- ING SALES AND RECEIPTS	NUMBER OF FIRMS	% MANUFACTUR- ING SALES AND RECEIPTS
Small manufacturers	260,950	35.1	254,682	26.4	-2.4	-24.7
Large manufacturers	3,090	64.9	3,218	73.6	+4.1	+13.4
Total	264,040	100.0	257,900	100.0		

<sup>1</sup>Small manufacturers defined independent legal entity with total labor force less than 500 employees

<sup>2</sup>Major Industry Group 37 consists of motor vehicles, aircraft, locomotives, ships and boats, missiles and space vehicles

Source: Data compiled from 1958 Enterprise Statistics, Series ES3 #1, page 106, Table 8 "Selected Statistics of Single and Multi-Unit Companies, by Industry Division and by Employment-Size-Class of Company: 1958, page 106; and 1972 Enterprise Statistics, part 1, General Report on Industrial Organizations, ES72-1, Table 8 "Summary Statistics for Large Companies" and Table 5 "Company Statistics by Employment-Size-Class: 1972," both by U.S. Department of Commerce, Bureau of the Census.

One effect of this trend is that a few large companies control the larger markets, achieving economies of scale in production, distribution, and R & D efforts. Small firms on the other hand, are left to identify and serve the needs of remaining market segments in which the larger firms are not interested. These "pockets" in the market place may be: (a) currently too small to attract the interest of the large firms; (b) declining in size; or (c) requiring a variety of custom products too diverse for cost efficient mass production.<sup>22</sup> A Fortune 500 company, for example, may require annual sales of \$20 million and a return on investment of 22 percent as a minimum market condition to approve a new product line.<sup>23</sup>

Another effect of this trend seems to be a decrease in the aggregate technological impetus provided by small firms. Small firms have traditionally been innovative but, for the reasons discussed earlier in this section, manufacturing firms are increasingly in a position where the motivation to engage in technological innovation is minimal. Why should a small firm undertake the risks necessary to develop a new product line? As soon as success seems possible, the small innovative firm may find at its back door a manufacturing plant, owned by a national corporation, which has easier access to capital, more experienced management, in-house lawyers to engage in patent litigations, and guaranteed access to the markets through affiliated retailers and wholesalers.

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<sup>22</sup>Ibid reference #21.

<sup>23</sup>Roberts, Edward B. "Technology Strategy for the Medium-Size Company," Research Management (July 1976), p. 30.

### Type A Firms (Pocket Markets)

For the increasing number of small manufacturers which find themselves in the above situation, their objectives in technological innovation are rather narrow: modifications in production processes to reduce costs and incremental product improvements over long time periods. These firms are referred to as Type A in this report and are typified by industries present in every community which "provide needed products for local consumption" (i.e., printing shops, bakeries, bottling plants and processed dairy products, etc.)<sup>24</sup> Since these firms serve limited markets, and the risks in developing new products are relatively high, their innovation objectives and scheduling are controlled by the demands of their "pocket markets." Large firms, by comparison, exert much more control in their larger markets through national advertising and retail outlet system with trained sales personnel.

It is impossible at this point to determine whether this two-tiered manufacturing sector actually results in "depressing the level of the whole economy" as Shanks suggested, but there is no doubt that the historical role played by small manufacturers in the nation's technological evolution is being altered by the growth of large corporations.

To reiterate, Type A firms serve the needs of small "pockets" in the marketplace and their situation is rather static. The majority of these firms manufacture consumer goods in mature industries, and their interests in terms of technological innovation are rather narrow:

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<sup>24</sup>Baumbach, Clifford M. and Kenneth Lawyer. How to Organize and Operate a Small Business, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1978, p. 7.

processes to reduce production costs and incremental product improvements over long time periods. Two other categories of small manufacturers can also be identified and their descriptions follow.

#### Type B Firms (Captive Markets)

These are the captive firms which serve as subcontractors and suppliers to large firms which in turn manufacture high bulk and often high technology capital goods. Baumbach and Lawyer state that, ". . . the mass production system is often dependent upon this type of firm." Probably the best example of such firms can be found in Industry Group 37 (manufacturers of motor vehicles and aircraft, etc.). It is significant that this Industry Group, which also includes aerospace--one of the most innovative and R & D intensive areas--has experienced a net growth of small manufacturing firms. Between 1958 and 1972, the number of large manufacturers remained steady at 188, but the number of small manufacturing firms increased by 24 percent, from 5,615 to 6,964.<sup>25</sup> Type B firms in this particular Industry Group range from minimal technical sophistication to state-of-the-art expertise in very specific technical disciplines.

Very little is known about the technological abilities and needs of these firms, but two statements can be made: (1) depending on the industry which they serve, these firms can contribute significantly to its growth and expansion; and (2) their dependence on one or a few large

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<sup>25</sup>U.S. Department of Commerce. 1958 Enterprise Statistics. Part I, General Report, U.S. Census Table 9, p. 123, and 1972 Enterprise Statistics, Table 5, Bureau of Census.



industrial customers is probably a constraining factor in terms of management's willingness to risk technological innovations beyond those deemed necessary to match the requirements specified by their industrial customers.

#### Type C Firms (New Markets)

These pioneering firms may become the IBM's and Xerox's of the future. They are referred to as venture, entrepreneurial, or high technology firms and their individual survival is dependent upon the ability of their management to maintain a high rate of growth based on intense and continuous application of the most advanced technology available. Ordinarily, such firms are found in new industries--e.g., microcircuitry in the 60's, laser technology in the 70's--and they seek to obtain the largest market segment in the shortest time period.

Needless to say, not all Type C firms succeed. But they generally either fail or succeed with a BANG! These firms take very high risks in trying to open up new industries or markets, and such risk levels have usually kept the large manufacturers patiently standing by, studying the evolving products and markets. However, this situation has been changing over the past few years. Large firms wishing to expand their product lines with a minimum of risk are now more willing to spin off divisions (e.g., Exxon with Qwx and Qwip) or to enter joint ventures with one or more Type C small companies to explore the new market possibilities. These joint ventures provide the large firm with access to advanced technology to maintain its own market position with limited risk. In turn, the large firm can provide the eager and talented entrepreneur with capital, as well as marketing and production assistance.<sup>26</sup> This strategy

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<sup>26</sup>Ibid, reference #2, pp. 110 and 116.

by large firms should increase the competition for the independent high technology firms and increase their value as joint venture partners. Of all small manufacturers, Type C firms require the greatest and most advanced technological inputs.

The study of Region VIII (Colorado, North and South Dakota, Wyoming, Montana and Utah) small businesses by Roger Nelson, et al, included a profile of a "representative" high-technology firm. While the profile which follows may not be representative of all high-technology firms everywhere, it does describe one small high-technology business which had the same characteristics of the majority of similar businesses in Region VIII. In 1978, 100 high-technology small businesses were operating in the region.

1. The corporation has been in business for over 20 years.
2. It employs from 1 to 50 people, with 1 to 5 persons directly involved in R & D.
3. Most of its R & D personnel have B.S. degrees; a few have M.S. degrees.
4. They were recruited by employee referrals.
5. The firm developed three new products in the last five years.
6. The production development time became longer recently because of government regulations and complexity of development.
7. Its 1979 products [were] still in the conceptual stage of development.
8. Lack of capital and increased government regulations are preventing the production of last year's product.
9. The company applied for 10 patents and received 7 in the past 5 years; the firm owns 20 proprietary products.
10. Independent and university laboratories and personnel are used for its R & D projects.

11. Industry provides the firm with most of the necessary technical information.
12. Most of its R & D funds are generated through depreciation and profits.
13. The firm is reluctant to bid for government contracts.
14. The company has \$1 million in assets, \$500,000 annual sales and \$100,000 R & D expenditures. Its average growth rates for these categories were 20 percent, 23 percent, and 8 percent respectively in the past years.<sup>27</sup>

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<sup>27</sup>Ibid, reference #16, p. 89.

### SECTION III. SMALL MANUFACTURERS AND TECHNOLOGY ACQUISITION

Small firms are finding it difficult to survive, to maintain profits, and to keep up with changing technology and increasing competition. Part of these problems are due to inadequate use of information and appropriate information sources.

Theodore Cohn and Roy Lindberg, authors of Survival & Growth: Management Strategies for the Small Firm, stated that sound growth is the best assurance of a firm's ability to survive and those companies best suited to achieve sound growth are those whose managers are "well aware of what's going on in the larger world, that reconcile what they've learned with what they can do; and that organize properly to do it."<sup>1</sup> They conclude that since decisions and control are information based, then "survival and growth are information-dependent."<sup>2</sup>

James "Mike" McKevitt, Washington Counsel, National Federation of Independent Business, stated during his testimony before the Senate Select Committee on Small Business that, "Small business needs two types of information . . . one segment needs general marketing assistance, e.g., marketing, cash flow, etc., [and] another segment needs access to the latest technology."

Many information sources are available to small business for obtaining both types of information, but little is known about small business,

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<sup>1</sup>Cohn, Theodore and Roy A. Lindberg. Survival & Growth: Management Strategies for the Small Firm, New York: AMACOM, 1974, pp. 10, 11.

<sup>2</sup>Ibid, p. 58.

particularly small manufacturer use of these available resources. The results of several research studies on external and internal information sources used by small businesses are summarized in this section, followed by several examples to illustrate how they have acquired and used NASA technology.

#### External Sources

Trade associations publish statistical data and abstracts which can provide small business management with information about individual markets, competitive products, and available services. These organizations keep "tabulated financial, operating and marketing information which can be used as a measure" of a company's own, or a competitor's performance. Cohn and Lindberg suggest trade journals, advertisements, catalogs, price lists, association meetings, as well as personal contact with distributors, mutual customers . . . ex-employees of competitors and their own sales people as other valuable sources of market information.<sup>3</sup>

Federal agencies such as NASA, the SBA, and Department of Commerce, provide technical as well as managerial assistance to help small business. A variety of information formats are available including printed materials, consultants, computerized searches, training programs, audiovisual materials, conferences and seminars, and so forth. While the SBA does not develop technology, it does help in the dissemination of technology developed

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<sup>3</sup>Ibid, pp. 20, 27, 165.

by other government agencies. One of the SBA's responsibilities is to see "that any produced technology which has or may have commercial utilization is made available to the small business community."<sup>4</sup> While NASA and DOD studies have shown that the brief type of printed forms used in the past by the SBA for technology transfer are not particularly successful,<sup>5</sup> some SBA services are useful sources of information to small business particularly with "problem-of-the-day concerns and where timeliness is often a crucial factor."<sup>6</sup>

Conclusions made by Professor Raymond Haas of West Virginia University following his study of thirty firms, as cited in Technology Diffusion, apply to small business' need for new technology. He observed that, in general, interest in new technology, or product development occurs when "present product output does not give the desired rate of return; when components of present products are in short supply, or become unavailable; when customers needs and wants can be stated or forecast; and when accidental encounter with opportunity indicates the desirability for a change." For some firms, he said, this interest in the development of new products is an ongoing process, while for others, it is only infrequent. But, he predicts that all firms must do it at some time using

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<sup>4</sup>U.S. SBA. SBA What It Does, Pamphlet #OPI-6, U.S. SBA, 1976, p. 12.

<sup>5</sup>Leibowitz, Arnold H. Government Policy and Innovation: The Small Business Administration Experience. Washington, D.C.: National Science Foundation, December 1974, p. 64. Also, Johnson, F. Douglas and Martin Kikus. NASA Technology Utilization Program: A Summary of cost Benefit Studies. Denver, Colorado: Denver Research Institute, University of Denver, December 1977.

<sup>6</sup>Kottenstette, James P. and Jerome J. Rusnak. "A New Perspective on the Intersectoral Movement of New Technology," Denver Research Institute, Denver, Colorado. Paper presented in 1972. Reprint, p. 107.

company developed technology or technology from other resources in order to produce new products, better products, or better ways of producing old products.<sup>7</sup>

In support of this theory, Alan Cottrell, author of "Technological Thresholds," stated that "any manufacturing firm or organization in modern industry must bring out new or improved products and update its manufacturing process regularly if it is to withstand technological competition from rivals in its own field or from invaders in neighboring fields" and because many market advantages belong to those who lead with fully developed and tested new products.<sup>8</sup>

The Region VIII small business study conducted for the SBA by Roger Nelson, et al, showed that the:

Small R & D businesses [in the study sample] used the facilities and personnel of independent laboratories, universities, private institutions and libraries frequently. About 80 percent of the businesses used these facilities at some time . . . industry and educational institutions were the most utilized sources of technical information. Private institutions and specialized libraries followed . . . government laboratories were seldom used.<sup>9</sup>

Saul Herner's 1957 study of 500 small businesses in food processing, electricity/electronics, metal fabrication, and textiles/apparel industries,

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<sup>7</sup>Hough, Granville W. Technology Diffusion, Mt. Airy, Maryland: Lomond Systems, Inc., 1975, p. 63.

<sup>8</sup>Cottrell, Alan H. "Technological Thresholds." The Process of Technological Innovation, Symposium Proceedings, Washington, D.C.: National Academy of Sciences 1969, p. 50.

<sup>9</sup>Nelson, Roger H., Edwin Tiffany Hawks and Ali Rexa Malekzadeh. "The Role of Small Business in Research and Development, Technological Change and Innovation in Region VIII," The Regional Environment for Small Business Entrepreneurship in Region VIII. Denver Research Institute, for the Office of Economic Research, U.S. SBA, 1979.

as reported in Technology Diffusion, determined that these firms were largely dependent upon "suppliers and to a lesser degree on trade journals for information on new products and techniques."<sup>10</sup>

Another SBA supported study of 162 Colorado firms revealed that trade associations were "considered by 38 percent of member businessmen as their most important source of business information . . . with periodicals and trade journals providing the majority of the business information."<sup>11</sup>

Hough also reported a study by Christopher Scott of the Central Office of Information, The Social Survey, London, which included an interesting point about the use of periodical literature. Scott contends that periodical literature was most helpful in supplying "useful information which is not being deliberately sought."<sup>12</sup>

A Denver Research Institute (DRI) study conducted for NASA in 1967 revealed information about the technology acquisition behavior patterns of R & D and engineering personnel of selected firms in additional industries. This survey questioned individuals within various firms who had responsibilities to acquire such information. A large portion of the firms selected were small. Sixty-two commercial manufacturing firms in four industries: battery, printing machinery and reproduction equipment, industrial controls, and medical electronics were examined to

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<sup>10</sup>Ibid, reference #7, pp. 56, 212, 213.

<sup>11</sup>Ibid, p. 212.

<sup>12</sup>Ibid, p. 51.



determine which channels of information were the most utilized.

Of the "17 external channels ranked in usefulness for current awareness and problem solving, professional journals, trade publications, meetings (including conferences and trade shows), supplier personnel, vendor catalogs, textbooks and handbooks ranked as the top six." Of internal sources used, "people, past experience, libraries (primarily relating to larger firms), and R & D were found to be as useful as external sources."<sup>13</sup> (See Table III-1 below from this study)

TABLE III-1. SIX MOST IMPORTANT CHANNELS FOR ACQUIRING TECHNOLOGICAL INFORMATION FROM OUTSIDE THE FIRM (ranked from top down in each category)

TYPE OF INDIVIDUAL	MODE OF TECHNOLOGY ACQUISITION	
	FOR AWARENESS	FOR PROBLEM SOLVING
Research-Oriented	Journals Meetings Trade publications Texts Consultants Gov't publications	Journals Texts Consultants Meetings Libraries Supplier personnel
Product-Oriented	Trade publications Journals Meetings Catalogs Supplier personnel Texts	Texts Supplier personnel Catalogs Trade publications Journals Meetings
Technical Management	Trade publications Journals Meetings Supplier personnel Catalogs Texts	Supplier personnel Journals Texts Catalogs Consultants Meetings

<sup>13</sup>Gilmore, Jack S., et al. The Channels of Technology Acquisition in Commercial Firms and the NASA Dissemination Program, Denver, Colorado: Denver Research Institute, 1967.

Some of DRI's pertinent observations and conclusions<sup>14</sup> are included here:

Technology is classified here into six types: (1) basic scientific knowledge, (2) design concepts, (3) analytical techniques, (4) production techniques or performance data, (5) new products, materials or services, and (6) new applications for existing products, materials, or techniques. Each type of technology interests different research, development, and engineering people at different points in time, and each may diffuse through unique patterns of information channels.

The use of technical information depends in part on whether the potential user is: a research-oriented person or a product-oriented individual; a key decision-maker in the firm or a relatively powerless lower-echelon engineer; an innovative person or an individual satisfied with the status quo. Each utilizes different patterns of information channels and sources, each perceives and appraises an innovation differently, and each plays a different role in the technology acquisition and application process.

. . . different types of individuals rely on different sources and channels for acquiring technical information, but every individual's information-seeking activity has multiple dimensions.

The organization environment within which technology is generated, transferred, or acquired affects the transfer process. Is the industry old and traditional or a vigorous emerging one that values research results and depends heavily on a broad range of technology? Is the industry's market subject to competitive invasion by firms now outside the industry? Is the firm highly specialized or widely diversified? Does management prefer innovations which are revenue-producing or cost-reducing? Is the firm an assembler of components or does it produce all its own products? Does the firm have an effective library or an information acquisition system? Is the firm large or small?

The size and scope of company libraries and information services tended to increase with size of firm, but other factors appeared to be more important in determining the strength of a firm's acquisition program: dependence on advanced technology, strong emphasis on research, management philosophy, and whether the firm was in a newly emerging and growing industry.

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<sup>14</sup>Ibid, pp. 14-19.

Ready access to and familiarity with particular information channels appeared to be major determinants of the channels an individual selected to acquire technical information.

There were major differences among the industries in the types of channels relied on, in the variety of channels utilized, and in the time devoted to acquiring technical information.

Three types of individuals, identified as research-oriented, product-oriented, and technical management, displayed very different patterns of information acquisition activity. They differed in the amount of time spent in acquiring information and in the types of information channels they used.

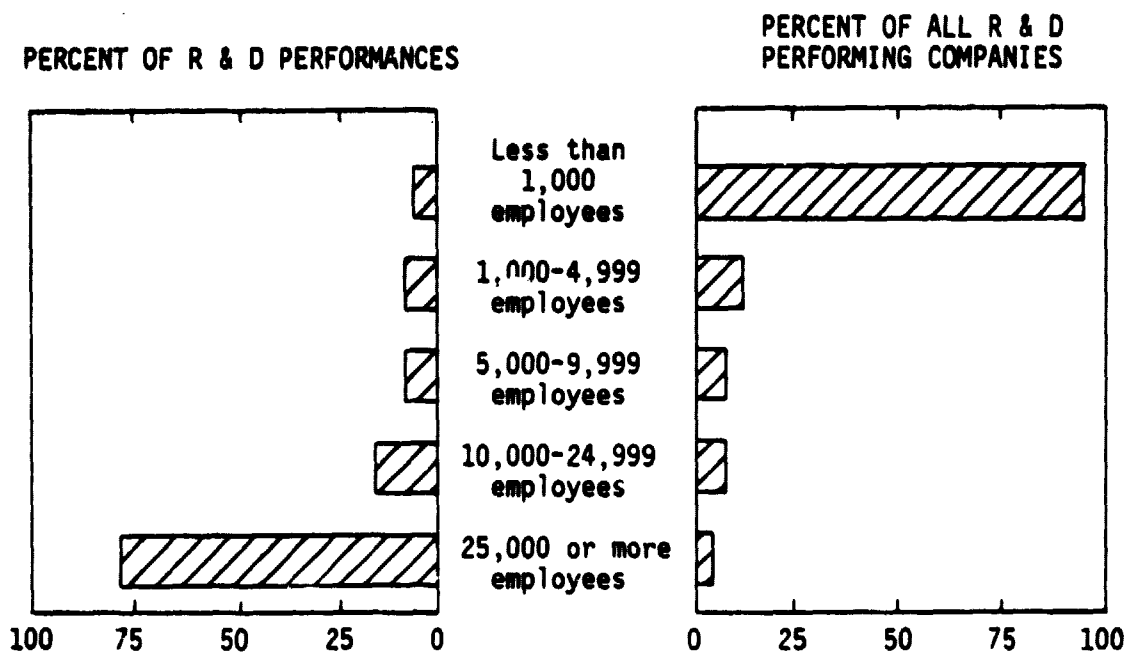
### Internal Sources

Internal sources available to small businesses to gain access to new technology include R & D by their own research scientists and engineers, bringing in new personnel having knowledge of advanced technology, participation in government R & D contracts, and use of in-house library resources by a few high-technology firms.

With regard to R & D, Hogan and Chirichiello reported in Research Management in 1971 that 10,000 small companies (with fewer than 1,000 employees) utilized only 5 percent of all funds allocated in the nation toward research and development (in 1975 the National Science Foundation reported a 4 percent figure--see Figure III-1). About 90 percent of these firms were in manufacturing. Those small manufacturing firms with a formal R & D program allocated in 1971, on the average, about \$65,000 for R & D and had approximately two professionals working in this area. Smaller facilities had only one individual filling several responsibilities.<sup>15</sup>

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<sup>15</sup>Hogan, Thomas and John Chirichiello. "The Role of R & D in Small Firms," Research Management, Vol. 17, No. 5 (Nov. 1974), p. 26.



Source: Research and Development in Industry 1975, page 6, and Table B-9, p. 36.

FIGURE III-1. R & D PERFORMANCE BY COMPANY SIZE: 1975

In contrast, the recent Region VIII study revealed that the majority of small R & D firms in 1978 had from "1 to 5 employees performing these tasks while 17 percent had as many as 6 to 10 serving in this capacity, with an average turnover rate of about 10 percent."<sup>16</sup>

A study conducted in 1963 at the University of Nebraska yielded some information about why some small manufacturers did not institute formal in-house R & D programs. Of the 152 firms studied, 37 percent could not afford such a program, 1 percent (2 of 152) stated that they relied on outside research firms for R & D needs (see Figure III-2) and 20 percent

<sup>16</sup>Ibid, reference #8, p. 81.

	(2) Most signifi- cant	(3) Of very great signifi- cance	(4) Of some signifi- cance	(5) Of little or no signifi- cance	(6) No judg- ment	(7) Total Cols. (3) through (6)
(1) A formal research pro- gram is too costly for our firm to support	37%	63%	16%	16%	5%	100%
(2) Research is carried on by raw material or parts suppliers and machine builders and made available to our firm	20	41	35	18	6	100
(3) Our firm has been able to make satisfac- tory technological ad- vance through informal (as opposed to formal) research programs	14	38	31	23	8	100
(4) Our firm has never given serious consider- ation to establishment of a formal research program; no need for such a program	10	27	13	46	14	100
(5) Research is carried on by parent firm and made available to our firm	9	10	4	63	23	100
(6) Other reasons	9	9	1	1	89	100
(7) Our firm employs the services of research firms, that is, we use the services of re- search specialists	<u>1</u>	6	7	74	13	100
Total (Col. 2)	100%					
n=152						

FIGURE III-2. REASONS FOR NOT SPONSORING FORMAL RESEARCH PROGRAMS

Source: Research Activity, Product Diversification, and Product Differentiation by Small Manufacturing Firms in Nebraska, 1963, page 29, prepared by Campbell R. McConnell and Wallace C. Peterson of University of Nebraska.

depended on the R & D efforts of suppliers or machine builders with which they do business.<sup>17</sup>

The decline of R & D scientists and engineers employed within this sector supports the contention that the majority of small manufacturers no longer have a major interest in technological innovation. In 1957, 19 percent of the R & D scientists and engineers in the country were employed by firms of less than 1,000 employees as compared to 70 percent by firms with over 5,000 employees. By 1976, smaller firms employed only 8 percent of the R & D scientists and engineers while the larger group of firms employed 83 percent.<sup>18</sup> The decline for small manufacturers is probably more significant, since these figures also include R & D personnel in several non-manufacturing sectors (research laboratories) which also employ less than 1,000 employees.

Relating to this theory, Hough, author of Technology Diffusion, in a discussion of the decline in the number of patents issued to individuals--80 percent in 1900, 40 percent in 1957 and 28 percent in 1967--repeated comments by Edwin Mansfield, Professor of Economics at the University of Pennsylvania. Mansfield concluded that "this shift is caused by technology's increasing complexity, more division of labor among specialists to synthesize a new product, and higher cost of experimental equipment and instruments."<sup>19</sup>

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<sup>17</sup>McConnell, R. and Wallace C. Peterson. Research Activity, Product Diversification, and Product Differentiation by Small Manufacturing Firms in Nebraska, University of Nebraska, 1963, p. 28.

<sup>18</sup>National Science Foundation. Research and Development in Industry, 1976, Washington, D.C.: NSF, 1977, p. 31.

<sup>19</sup>Ibid, reference #7, p. 39.

Hogan and Chirichiello mentioned other difficulties that small manufacturers encounter in their R & D efforts. There are major problems in attracting and then keeping qualified persons for the R & D work. Frequently, it is difficult for the small firm "to match the salaries . . . fringe benefits and security offered by larger firms." Many of these small companies must also depend upon the R & D professionals to fill a number of roles and to be able to "shift between research, development, and production."

They also state that those firms committed to R & D programs place a high priority on their R & D projects and, "because of the expense associated with maintaining diversified R & D efforts, most small companies will spend their R & D dollars in areas closely related to their current business." Since these firms cannot afford "to finance very many unsuccessful projects [they] concentrate their R & D efforts on short-term . . . low risk projects."<sup>20</sup>

In addition, lack of capital and fluctuations in the economy have caused many firms to cut back or eliminate their R & D programs. Small firms, particularly during a sagging economy must frequently decrease efforts in new product development and concern themselves primarily with cost-saving process improvements.

Government R & D procurement contracts can be a valuable technological resource for small business. Carolyn Hargraves noted in her article on federal R & D expenditures that such opportunities offer some

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<sup>20</sup>Ibid, reference #15, p. 28.

small businesses a chance to be introduced to unfamiliar technology, and to have their employees gain new skills. These firms may be able to be in on the birth, growth and use of brand new technology and methods.<sup>21</sup> These firms can sometimes capitalize on their early access to such technology by capturing new markets for their improved products and/or capabilities based on the new technology.

A number of studies have shown that few small firms have formal library facilities and generally do not have any one person assigned to acquiring technological information. It has been found, however, that firms doing more advanced R & D (i.e., high-technology firms), tend to have more interest in gathering and storing technical and scientific information as a firm, or by individuals in such firms.

#### NASA Technology

The previous subsections characterized small businesses as receivers and generators of technology. NASA's role as a technology source is illustrated below with examples of successful transfer efforts. A quantitative analysis of small business use for two of the agency's technology transfer services is given in Section IV.

The following examples are taken from the TRIS Program's Space Benefits 80-1, a compendium of documented transfer examples. They are classified according to transfer mode, or how the transfer happened.

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<sup>21</sup>Hargrave, Carolyn Hooper. "Distribution of Federal Expenditures for Research and Development: Implications for Small Business," Federal Bar Journal, Volume 32 (Spring/Summer 1973), p. 187.



The major modes for small businesses are contractor applications, personnel transfer, interagency projects, and formal transfer services within the Technology Utilization (TU) Program. Transfer modes are significant because they provide a basis for analyzing and managing transfer activity from a technology source.

Contractor Applications. The primary type of contractor application is when expertise, designs or practices developed by a small firm with NASA funding are subsequently used in the firm's commercial activities. Another type is when a large prime contractor retains (e.g., a patent waiver) commercially useful technology that is later licensed to a small business. Contractor applications have not been systematically investigated nor characterized. Large firms, such as General Electric, have been successful in strategies to win government contracts that support the firm's long-term commercialization goals.

Contractor application examples:

An Ultrasonic blood flowmeter was designed to Ames Research Center specifications by a small California manufacturer, L&M Electronics. The non-invasive, directional flowmeter used the Doppler Principle and ultrasonics to measure the effects of high acceleration on distribution of blood in the circulatory system. Space applications include passenger selection criteria for the Space Shuttle. The company prototype, modified in response to an Ames's contractor evaluation, was found to be the optimum instrument for this measurement method. L&M commercialized the modified design under the name Directional Ultrasonic Flowmeter. About 10 to 12 units are sold annually for \$3,000 each with a smaller handheld unit priced at \$395. The units are primarily used for biomedical research, but other diverse applications include coal industry use to gage the flow of piped slurry, and use by food processors to measure flow rates of various liquid food products. One unit has been used in a heart-assist pump in an emergency room. (Space Benefits 80-1, paragraph no. R-7)

Mass flowmeters for low gas flow were developed to meet the specifications of an Apollo subcontractor for Lyndon B. Johnson Space Center by Tylan Corp., a small California manufacturer. Tylan introduced the gas flowmeter as a

commercial product in 1978. In the mid-70's, the product was used extensively in the U.S., Europe, and Japan for process control and manufacture of semiconductors, as well as in petrochemical production, medical instrumentation, heat transfer devices and thermodynamic analysis. Currently, the semiconductor industry is the primary customer for the flowmeters and flow controllers. Over 5,000 units are sold each year at an average price of \$500 each. Growth in annual sales has increased from \$300,000 in 1965 to almost \$3,000,000. Employment has increased from 20 to 80 persons. The majority of the company's business is based on fallout from the Apollo Program. (Space Benefits 80-1, paragraph no. B-14)

New production processes and designs for electronic systems developed for Lyndon B. Johnson Space Center, George C. Marshall Space Flight Center and Jet Propulsion Laboratory contractors by ELDEC Corp., included advanced designs for systems that condition signals from onboard instrumentation. ELDEC, a small business located in Washington, used the processes and designs to develop three new product lines: onboard truck weighing systems, onboard weight and balance systems for aircraft, and aircraft fuel flow control systems. The first truck weighing systems were used on logging trucks with over 2,000 systems sold at \$2,000 each. Since 1975, the market has expanded to include almost all types of highway transport trucks. Current sales total 1,000 units per year at \$2,100 each. The weighing systems allow drivers to maximize payloads while staying under legal highway weight limits. The aircraft balance and weight systems have been used on Air Force C-5A's and Lockheed L-1011's and allow pilots to optimize aircraft trim settings and minimize fuel consumption. Sixty systems have been installed on L-1011's for \$12,000 each. The current price is \$13,000. Fuel flow control systems have been used on Boeing 747's, Douglas DC-10's and some military aircraft. ELDEC has been successful in expanding its commercial product lines so that it is now a middle size manufacturing firm with almost 900 employees. (Space Benefits 80-1, paragraph nos. K-8 and M-13)

A Die Set for flared metal tubing was developed for NASA Western Operations Office. The Patent rights were waived to General Dynamics Corporation, the prime contractor, which sold the production rights to Dynaflare Industries, Inc., a small California manufacturer. Dynaflare produces a line of automated tube flaring machines. Retail costs for its three models vary from \$11,900 to \$20,000. The machines are used to fabricate heating, air conditioning, hydraulic and oxygen systems. Machines have been purchased by government and industry manufacturers. Customer benefits include 25% savings in labor, 20% savings in

fabrication costs, and increased reliability in precision parts. It is estimated that the Navy is saving millions of dollars in time and materials as a result of its use of this machine. (Space Benefits 80-1, paragraph no. B-35)

Personnel Transfer. As skilled individuals migrate from NASA-funded employment into other economic sectors, they often adopt and apply knowledge they developed during the NASA work. There are two major types of personnel transfers. The most significant one for the small business sector is when skilled individuals become entrepreneurs who create or join small companies to develop new products or services with their acquired knowledge. The other type is when the skilled individual improves practices and/or designs for a new employer. The only examples available for the second type are large businesses.

Personnel transfer example:

Heated space suit technology developed for Lyndon B. Johnson Space Center was used by a former contractor employee to develop new product lines for Comfort Products, Inc., a small Colorado manufacturer. The technology included electric heating element designs, thermal and electrical insulation materials, specialized fabrics, flexible joint designs, and production processes. The company produces heated protective clothing for use by consumers involved in sports and recreational activities. The original product, electrically heated "Lunar Gloves," were priced at \$30 per pair. Currently the line includes "FOOTWARMER II," a built-in heating system for ski boots that retail for \$80, and "PROFOOT" insoles that cushion and insulate any type of footwear and sell for \$3. The insoles are included in selected models of Adidas and Converse athletic shoes. Total sales have doubled since 1976, and now exceed \$1 million. A new line of nonfogging heated ski goggles is to be introduced. (Space Benefits 80-1, paragraph no. C-13)

Interagency projects. The joint efforts by NASA and a second agency, such as LANDSAT with the U.S. Geological Survey and weather satellites with the National Oceanographic and Atmospheric Administration, are generally designed to develop new capabilities related to the second

agency's legislative mandates. Two types of transfer activity occur in this mode. The first is when the second agency's user audience acquires and applies the output of new or improved services. This occurs, for example, when small companies use LANDSAT data from the USGS facility in South Dakota or weather satellite data from one of NOAA's services. The second type is when small firms develop new products and commercial markets that were prototype tested by the interagency project.

Interagency project example:

During 1975-1977, The Lyndon B. Johnson Space Center, the Texas Research Institute of Mental Sciences, United Action for the Elderly, the University of Texas, LBJ School of Public Affairs, the Texas Department of Public Welfare and the Ford Foundation sponsored an experimental project, called "Meal System for the Elderly," to demonstrate that freeze-dried foods developed for NASA could provide easy-to-prepare, nutritious and well-balanced meals for senior citizens. Several small contract suppliers participating in the project used Compressed/Freeze Dried Food technology originally developed for Johnson Space Center by the U.S. Army Natick Laboratory. Innovative Foods, a small California firm developed a product line for sale to major food processors and government organizations. Oregon Freeze Dry Foods, Inc. developed a food system package for seniors called EASY MEAL. Cartons of 12 complete meals are priced from \$20 to \$24. Publicity from the inter-agency project led to the formation of a third company, Skylab Foods, Inc. in New York to market modified versions of the meal system. Production began in 1978 with approximately 100,000 meals being sold in the same year. Customers are primarily homebound handicapped and senior citizens. New product packages are being developed for the blind, camps, and schools without normal kitchen facilities and underdeveloped countries. (Space Benefits 80-1, paragraph no. F-9)

TU Program services. The TU Program provides several services which are used by small businesses to acquire potentially useful NASA technology. These include: selective dissemination of documents, or Technical Support Packages (TSP's), through announcements such as NASA Tech Briefs; computerized retrospective searches and personal contacts through a network of Industrial Applications Centers (IAC's), conferences that

present selected technology to potential users; and personal assistance through TU Offices located at each NASA Field Center. The majority of small business transfers involve TSP's. Conferences and personal assistance are less significant in terms of total transfers although these transfer attempts are more often successful. Very few IAC transfer examples are fully documented at this time.

TSP examples:

A Welder for fine gage wire was developed by Langley Research Center. The TSP designating this technology was used by Fibra-sonics Inc., a small Illinois manufacturer to develop a butt welder for producing medical instrument components. Thermocouple wires as small as 0.001-inch diameter can be joined without buckling. The welding technology saved \$5,000-\$10,000 in development costs for new production equipment. The benefits attained from timely market introduction of improved products (estimated at \$50,000 since 1972), are expected to continue at \$10,000 per year. Other benefits include improvements of instruments used in medical surgery such as cataract removal. (Space Benefits 80-1, paragraph no. Q-18)

A Diode-quad bridge circuit design, developed by Ames Research Center for use with solid state sensing components minimizes signal distortion, and performs well with various transducers and permits the transducer to be conveniently grounded. North American Manufacturing Co., a small business in Ohio obtained a non-exclusive NASA license and used the circuit design information to improve its combustion control products. Improvements have increased energy efficiency of furnaces used for industrial space heating, copper smelting and iron and aluminum shaping. Energy savings are estimated at 5% to 10%. By 1977 approximately 60 control units were sold @ \$1,000 each. (Space Benefits 80-1, paragraph no. B-77)

A Power factor controller developed by George C. Marshall Space Flight Center is an electronic control circuit that can be added to AC induction motors to conserve energy. It raises the power factor from 0.2 to 0.8 by reducing voltage to the motor during partial load operation and achieves a 10-20% reduction in electrical energy required for variably loaded motors. At least 10, mostly small firms have obtained nonexclusive NASA licenses to manufacture this invention, and at least 2 of those firms have developed products and initiated market development. Electronic Relays, Inc., a small Illinois manufacturer has developed two controller models for industrial motors:

one for 1/16-hp motors that sells for \$5 and one for 100-hp motors that sells for \$1,000 in large quantity lots. Electronic Relays offers several product lines of solid state relays for a variety of industrial uses and has successfully introduced other important innovations in recent years. W.J. Purcell Co. a small Ohio firm has developed one model, a single-phase controller for industrial motors, and is developing a three-phase model. Widespread publicity for this energy conserving invention has generated many inquiries from potential customers. (Space Benefits 80-1, paragraph no. B-95)

Conference example:

A Bardons and Oliver, Inc. representative became aware of the advantages of fluidic control devices while attending the 1964 NASA Technology Utilization Conference held at Lewis Research Center. The fluidic controls developed by Lewis for rocket engines were used by this small Ohio manufacturer to replace electronic controllers in its line of turret lathes. The fluidic controllers are manufactured at half of the cost of electronic controllers and are simpler, more reliable and are easier to maintain. Produced since 1967, the fluidic-controlled lathes sell for \$40,000 to \$80,000. (Space Benefits 80-1, paragraph no. B-8)

Personal assistance example:

Weed Instrument Company, Inc., a small manufacturer of temperature sensors in Elgin, Texas, asked the SBA office in Dallas for assistance in locating information on chemical vapor decomposition of silicon carbide. The SBA referred the company to the Lewis Research Center Technology Utilization Office which located and compiled the appropriate data. The information which included data on insulation materials, techniques and efficiencies was used by Weed Instrument Co. in the development of a new, high temperature (over 3,000°F) sensor product. Because of the SBA/NASA/ LEWIS assistance, the company was able to identify a sealant with high temperature insulation characteristics. Several hundred of the sensors have been sold at prices varying from \$800 to \$1,200. Some units have been used in coal gasification turbines. The new product has helped the company to almost double its size and increase its sales to over \$1,000,000 in 1978. (Space Benefits 80-1, paragraphs no. H-28)

The studies discussed in this and earlier sections show that clearly defined technology acquisition patterns for small businesses cannot be easily defined. Usage by individuals and by firms is extremely diverse

and is subject to change over time depending upon many factors in the business environment. The studies do indicate, however, that many small firms of similar size, within the same industry and in similar stages of growth, probably have like needs for management and technical information. This suggests that it may be possible to identify, aggregate and satisfy such needs with specifically designed technology transfer services.

#### SECTION IV. SMALL BUSINESS AND THE TU PROGRAM

Small business technology transfer activity from two TU Program Services is characterized in this section: Publications Program and Industrial Applications Center (IAC) Program. These two services generate the majority of transfers to the small business community through the Agency's formal transfer efforts. The TU Program goal is to provide the widest practicable and appropriate dissemination of new technology produced by NASA.

Cost benefit evaluation studies were conducted in 1976 and 1977 for these services.<sup>1,2,3</sup> The following data are from these studies as well as the TRIS Program data bank. The subset of evaluation data for small business was analyzed as part of the current study. These small business data are reasonably representative of one subpopulation of TU Program small business clients, although the evaluation random sample was selected from the whole population rather than this subpopulation.

##### Publications Program

The primary components of the Publications Program are its announcement formats and the technical documents, or Technical Support Packages

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<sup>1</sup>Johnson, F. Douglas, et al. NASA Tech Brief Program: A Cost Benefit Evaluation. Denver, Colorado: Denver Research Institute, University of Denver, May 1977.

<sup>2</sup>Anderson, Robert J., Jr., William N. Lanen, Carson E. Agnew, et al. A Cost Benefit Analysis of Selected Technology Utilization Office Programs, Princeton, New Jersey: Mathtech, Inc., November 1977.

<sup>3</sup>Johnson, F. Douglas and Martin Kokus. NASA Technology Utilization Program: A Summary of Cost Benefit Studies. Denver, Colorado: Denver Research Institute, University of Denver, December 1977.



(TSP's), which are announced. The current format is NASA Tech Briefs, a quarterly journal of one page Tech Briefs organized according to technology categories. Reader service cards are included for making TSP requests.

Each issue of the Tech Brief journal contains about 100 new technology items. There are TSP's associated with 80 percent of the Tech Briefs and the others provide a self-contained description of the technology. The journal is designed to serve as a current awareness medium and problem-solving tool for the user. In 1979, about 63 percent of the 43,000 subscribers were located in facilities with under 500 employees. It is not known what proportion of these are small facilities for large companies as compared to small independent businesses.

Between 1963 and 1976, Tech Briefs were published separately and other formats were also used to announce new technology. Another format was TU Compilations which were booklets to announce TSP's aggregated by specific technical area (e.g. Cables and Connectors, or Digital Circuits for Computer Applications). Originally, TU Compilations announced technology items that were not reported in Tech Briefs, later they also included items which had previously been announced through a Tech Brief.

The Small Business Administration, in cooperation with the NASA TU Program, has also experimented with a number of announcement formats in its efforts to transfer aerospace technology to the small business sector. One of the early formats was an SBA version of the TU Compilation. A compilation on electronic components was particularly successful in establishing long-term use patterns by small businesses of Publication Program services. Between 1970 and 1972, TSP's were announced biweekly in Commerce Business Daily. The SBA also used flyers

and brochures which provided brief summaries for NASA Tech Briefs aggregated by subject areas. Reader service cards were also included in the SBA formats and large numbers of TSP's were often requested on individual cards. The SBA formats were frequently used by individuals in large firms.

From 1970 through 1977, NASA facilities received over 400,000 TSP requests through the various announcement formats (see Table IV-1 below). Since then, NASA Tech Briefs has generated about 200,000 TSP requests annually.

TABLE IV-1. NUMBER OF TSP REQUESTS, BY MECHANISM

	TECH BRIEFS	TU COMPILATIONS	SBA PUBLICATIONS	TOTALS
1970	9,791	6,300	-0-	16,019
1971	10,921	24,994	15,200	51,115
1972	10,219	32,618	51,471	94,308
1973	10,633	11,224	28,968	50,825
1974	11,000	30,832	3,814	45,646
1975	9,036	13,225	235	22,496
1976	19,990	21,199	8,077	49,266
1977	<u>53,557</u>	<u>3,316</u>	<u>32,235</u>	<u>89,108</u>
	135,145	137,408	146,500	418,853

Based on information from the TRIS data bank, approximately one-third of the TSP requests are from small (less than 500 employees) manufacturers. Small manufacturers in four groups account for over 60

percent of all requests from small manufacturers: fabricated metal products; non-electrical machinery; electric and electronic equipment; and instruments and related products. (See Table IV-2 below).

TABLE IV-2. SMALL FIRMS TSP REQUEST BY STANDARD INDUSTRIAL CLASSIFICATION (SIC)

STANDARD INDUSTRIAL CLASSIFICATION GROUP	
28-Chemicals and Allied Products	1,320
34-Fabricated Metal Products	1,769
35-Machinery, Except Electrical	3,077
36-Electric and Electronic Equipment	5,197
38-Instruments and Related Products	2,044
5X-Wholesale and Retail Trade	1,162
8X,7X-Services	2,286
Other	3,576
Total	20,431
n = 73, 015	

The SBA flyers have proven most effective in generating TSP requests from small businesses. In 1976, for example, 84 percent of the TSP requests generated by the SBA FA Series Flyers came from small business. However, they appear to be quite inefficient in transferring NASA technology to small manufacturers. Some of this inefficiency may be due to overly brief descriptions of the technology and a few titles which may have been misleading to some requesters. The TU Program announcement formats produced small business TSP request rates ranging from a low of 22 percent (1972 TU Compilations) to a high of 29 percent (1976 TU

Compilations). In 1976, 26 percent of the TSP requests generated by NASA Tech Briefs came from small business.

### Industrial Application Centers

The second major TU Program service is provided by seven Industrial Applications Centers (IAC's)\*. These IAC's provide a variety of information search services to fee-paying clients. The basic service consists of computerized retrospective searches (RSS) of NASA and non-NASA information systems performed by the center's technical staff in response to specific questions from clients. The IAC's differ in how the RSS is produced and prepared for the client. Three basic types of RSS are available: NERAC deals mostly in quick searches where the computer output is reviewed by NERAC personnel for relevance only (level 1 search); NIAC/USC uses the more recently developed interactive search method where the client participates in developing the search strategy at the computer terminal (level 2 search); and the other IAC's also produce searches which are edited and repackaged (level 3 search).

The SBA has been funding small business search services for the last few years at NIAC/USC and NERAC. The State of New Mexico funds a similar service at TAC. These free services have been well received in

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\*Formerly called Regional Dissemination Centers: Aerospace Research Applications Center (ARAC), Indiana University-Purdue University at Indianapolis, Indiana; NASA Industrial Applications Center, University of Pittsburgh, Pittsburgh, Pennsylvania; New England Research Applications Center (NERAC), the University of Connecticut, Storrs, Connecticut; North Carolina Science and Technology Research Center (NC-STRC), Research Triangle Park, North Carolina; Technology Applications Center (TAC), the University of New Mexico, Albuquerque, New Mexico; NASA Industrial Applications Centers, University of Southern California (NIAC/USC), Los Angeles, California; and Kerr Industrial Applications Center (KIAC), Southeastern Oklahoma State University, Durant, Oklahoma.

parts of the small business sector. No systematic analysis has been done to find out which small business markets are being served most effectively.

An additional IAC service was added in 1976 to complement the literature search services. Retired NASA management personnel are used as technical coordinators to assist in the client's problem solving process. Their experience in solving problems and awareness of NASA experts at various locations are utilized when client's questions can not be answered properly by search methods. A coordinator is located at each of NASA's major Field Centers.

Small businesses also obtain NASA technology through TU Program services such as Application Engineering Projects, Application Teams, Computer Software Management and Information Center (COSMIC), conferences and personal contracts. These services are not heavily used by small businesses and detailed evaluation results are not available to characterize small business usage.

#### Program Benefits

The TRIS evaluation studies in 1976 and 1977 were based on telephone interview data for random samples of service users. Over 700 interviews were completed. Table IV-3 shows the sample sizes and service populations which were sampled.

Three application modes were identified in the sample data as major categories for recipient use of a TSP or RSS:

Mode 0 - No application was or will be attempted and user's investment was negligible;

Mode 1 - The package was used only as a source for information content which was available from other sources; the only

TABLE IV-3. SAMPLE POPULATIONS AND SIZES

INFORMATION PRODUCT TRANSACTION	NUMBER OF TRANSACTIONS 1971-1976	SAMPLE SIZE
TSP Request <sup>(1)</sup>		
o Tech Brief 1976 Tech Brief; 1973 Tech Brief	56,900	180
o Tech Brief Journal 1976 Tech Brief Journal	12,250	90
o TU Compilation 1976 TUC; 1972 TUC	134,100	90
o SBA Publication 1976 SBA Flyer 1972 SBA F-1 Series 1972 SBA C-1 Series	107,750	89
Subtotal	<u>311,000</u>	<u>449</u>
Retrospective Search (IAC) <sup>(2)</sup>		
o Level 1 (Reviewed Only)	7,000	103
o Level 2 (Interactive)	850	90
o Level 3 (Edited)	<u>7,700</u>	<u>58</u>
Subtotal	15,550	251

(1) Samples were drawn from transactions that occurred in 1971, 1972, 1973, 1974 and 1976.

(2) Samples were drawn from transactions that occurred in 1976.

allowable economic effects are due to acquiring the package through a TU service as compared to other possible sources; and

Mode 2 - Technology from the package was, or will be, used in a product, process, or service; another technical alternative would have been used without the transaction and allowable economic effects are calculated from the difference in results with and without the transaction.

It should be noted that Mode 2 refers to applying the NASA technology described in the information product. Since the goal of various services is to facilitate the use of NASA technology in new applications, the cost efficiency of a service is enhanced by reducing the proportion of Mode 0's and increasing the proportion of Mode 2 applications.

The expected net benefit from each information product type in each application mode appears on Table IV-4. These values were calculated as 95 percent confidence lower bounds from the sample data. The magnitude of net benefits in Mode 2 depends, in part, on the investment cost to apply the technology from the TSP.

Aggregating data from all Publication Programs, small businesses were not as successful as large businesses in applying NASA technology. Their sample data proportion of Mode 2 applications was 5 percent, less than half the percentage for large businesses. As a result, the expected net benefit per TSP for large businesses was over twice the expected net benefit per TSP for small businesses: \$1,560 for large versus \$740 for small.

TABLE IV-4. EXPECTED NET BENEFIT VALUE PER  
ITEM BY APPLICATION MODE\*

ITEM	APPLICATION MODE		
	<u>0</u>	<u>1</u>	<u>2</u>
TSP	\$0	\$120	\$13,500
RSS	\$0	\$580	\$22,400

\*In 1976 dollars.

Note: Mode 2 expected values include the entire net benefit stream generated by the information product. For example, if a small company invested \$2,000 in 1972 to use a TSP on welding and realized annual cost savings of \$1,000 in 1973 through 1979, these yearly results were discounted, or compounded, to their 1976 value and the final net benefit value represents the entire net value of the stream in 1976.

As with other investment opportunities, small firms have less to invest than large ones so the net benefits to small companies were generally not the largest values in any data set. However, small firms often realized net benefits in the range of \$5,000 to \$30,000 from applying the technical contents of the TSP (Mode 2).

Small non-manufacturing firms were relatively inefficient in applying NASA technology. For these firms, the expected net benefit per TSP



was \$40, or approximately 5 percent of the corresponding benefit for small manufacturers (see Table IV-5 below).

TABLE IV-5. SAMPLE DATA MODE DISTRIBUTION  
FOR SMALL MANUFACTURING/NON-MANUFACTURING FIRMS

	SMALL MANUFACTURING FIRMS	SMALL NON-MANUFACTURING FIRMS
Mode 0	55.4%	66.7%
Mode 1	39.5%	33.3%
Mode 2	5.1%	0
	n=92	n=24

Several observations can be made about small manufacturers' use of NASA technology by comparing the sample data mode distribution for the various TSP announcement mechanisms. The change in formats from individual Tech Briefs to the Tech Brief journal in 1976 improved the efficiency of this transfer service. With the individual Tech Briefs, the small manufacturer's Mode 2 proportion was about 2 percent, but in the first year of its introduction, the journal increased this proportion to almost 7 percent. This increase indicates that the announcement format significantly affects the chances for technology use. Since small firms rarely employ librarians or other information specialists, the responsibility for obtaining relevant technical input from external sources is shouldered by an employee who has other primary responsibilities. Often, this individual is the president or a top manager who has little time available. Thus, the ease with which the information

can be reviewed and stored for future reference is a factor which impinges on the probability that the technology contained in the information product will be applied (see Table IV-6 below).

TABLE IV-6. SMALL MANUFACTURER'S APPLICATION MODE  
DISTRIBUTION BY ANNOUNCEMENT FORMAT

	TECH BRIEFS	TECH BRIEF JOURNAL	TECHNOLOGY UTILIZATION COMPILATION	SBA
Mode 0	35%	60%	37%	74%
Mode 1	63%	33%	48%	26%
Mode 2	2%	7%	15%	0
	n=17	n=15	n=22	n=38

TU Compilations appear to be over twice as effective as the Tech Briefs journal in transferring NASA technology to small manufacturing firms, although the journal's subscriber population was not well developed when the sample was taken. The SBA Flyers appear to be quite inefficient in transferring NASA technology to small manufacturers due in part to their brief form and a few ambiguous titles.

The sample data for IAC RSS clients do not provide as much detail for analysis of small business usage. It was not possible, for example, to analyze the usage by industrial sector. The results indicate a higher proportion of technology use by small businesses at a higher unit cost to the Agency. Aggregating the sample data for RSS's performed by four IAC's--NIAC/Pittsburgh, TAC, NERAC, NIAC/USC--small firms compared

favorably with medium/large firms. The aggregate proportion of Mode 2 applications was 16 percent for small firms, and 21 percent for large firms (see Table IV-7 below).

TABLE IV-7. SAMPLE MODE DISTRIBUTION FOR RSS TRANSACTIONS:  
SMALL VS MEDIUM/LARGE FIRMS

	SMALL FIRMS	MEDIUM/LARGE FIRMS
Mode 0	0	0
Mode 1	84%	79%
Mode 2	16%	21%
	n=122	n=78

The edited, repackaged Level 3 RSS, in some cases including the use of an IAC Technical Coordinator, was the most effective in transferring NASA technology to small firms. The small business proportion of Mode 2 applications for Level 3 RSS's was 35 percent, over twice the rate for TSP's and other RSS products (See Table IV-8 below).

TABLE IV-8. SMALL BUSINESS' APPLICATION MODE DISTRIBUTION BY RSS LEVEL

	RSS-1 (reviewed for relevance)	RSS-2 (client interactive)	RSS-3 (edited- repackaged)
Mode 0	0	0	0
Mode 1	92.7%	83.7%	64.4%
Mode 2	7.3%	16.3%	35.6%
	n=51	n=40	n=31

The small business sample data for individual IAC's was also reviewed. The subsidized small business services at TAC and NIAC/USC generate high proportions of Mode 2 applications. The interactive searches at NIAC/USC are particularly useful for introducing small businesses to new technology acquisition methods.

The last result from the evaluation data concerns the cost to produce user benefits. The Agency's unit costs depend on the service involved and how many transactions are produced from relatively fixed costs for each service. The users' costs are in the form of an investment to acquire, read, adapt and apply the technology contained in a TSP or RSS. This represents a risky investment since it is seldom possible to predict the usefulness of NASA technology before the investment is made. The variation in actual user costs and net benefits is quite large for all users. Table IV-9 shows the aggregate results for large and small business users. The correlation coefficients are above 0.9.

TABLE IV-9. NASA COST, USER COST, AND USER NET BENEFITS PER  
TSP OR RSS TRANSACTION\*

PRODUCT TYPE	AVERAGE NASA COST PER TRANSACTION	EXPECTED USER COST PER TRANSACTION	EXPECTED NET BENEFIT PER TRANSACTION
<u>TSP's</u>			
SBA Announcements	\$2	\$180	\$110
TU Compilations	\$30	\$260	\$640
Tech Briefs (single)	\$75	\$270	\$600
<u>NASA Tech Briefs</u>	\$65	\$330	\$910
<u>RSS's</u>			
Level 1 (reviewed)	\$100	\$250	\$1,300
Level 2 (interactive)	\$130	\$320	\$1,740
Level 3 (edited)	\$550	\$870	\$4,900

\*In 1976 dollars.

## SECTION V. OBSERVATIONS AND RECOMMENDATIONS

The previous sections summarized much of the available information about small businesses and their use of TU Program services. This section presents several observations and recommendations related to improving Program services for this large group of potential users.

Many small businesses and particularly small manufacturers may not be aware of the TU Program services, and/or may be aware of it, but may not be using it for a number of reasons. For example, the technology packages disseminated by NASA present a risky investment opportunity to small businesses which have fewer chances than large businesses to make mistakes and learn from them. In addition, some small business persons resist assistance from external sources. The various factors which account for the diversity and sometimes limited technology acquisition patterns of small business include managerial time constraints and capital limitations. But, since many small firms have a genuine need for technical and management information, the addition of Program services designed to satisfy specific market needs within this group can be potentially beneficial to the TU Program, the small business sector and eventually, the national economy through increased productivity.

### Small Business Market Development

While NASA technology is not expected to have a major economic impact in the small business sector, it might be disseminated in ways that increase total user benefits without significant increases in Program costs. The small business market is too fragmented to be served efficiently by a single small business service. The cost of providing IAC RSS's, for example, to large numbers of individual small firms would

be high and may not be necessary. A better alternative might be to identify and develop market segments which can be served with semi-mass produced, appropriate technology packages containing Tech Briefs or IAC search results. These could be repackaged from the existing services to fit markets aggregated by similar use situations (e.g., small electronics manufacturers).

Small manufacturers, the largest single potential market within the small business sector, have shown a high proportion of Mode 2 applications, yet overall small use of program services. Selected types of small manufacturers within this large group could be identified for targeted dissemination of information (TDI) via Tech Brief packages which could include process, product or management technology matched to identified technological as well as managerial needs of the user group. TDI packages patterned after the successful TU compilations could be designed to match the needs of the homogeneous types of users within or across industries. The TRIS Program is conducting an experiment to obtain more information on potential TDI services. The matching process is being developed from previous TRIS research concerning technology classification, pattern analysis for successful transfer activity, and transfer example data from the Program files. It has been verified that Mode 2 applications can be predicted five times more often than they occur at random among TSP requests. These results have not been specialized to small manufacturers but it should be possible to reduce the small business risk by selecting TSP's which are most likely to be used and by providing illustrative examples for how the technology can be used.

TDI packages based on process technology could be especially helpful to some small manufacturers, particularly during sagging economic periods when they have, by necessity, decreased interest in expansion and increased interest in cost-saving types of technology. Since the majority of NASA TSP's provide cost-saving information, TDI packages with process technology might be useful during these periods to some types of industries and firms, particularly Type B and less frequently, Type A and C. While cost-saving technology is useful to some firms at any time, increased dissemination of process technology during periods of recession would be appropriate because the majority of small firms lack capital for new product R & D.

Product technology could be useful to Type B firms that do not have funds available to perform their own R & D, but that need to improve, or expand their present line of products with proven technology, technology that would require little investment and adaptation for conversion into commercial and patentable products with a higher probability of profit. While this information would sometimes be useful to Type A firms, other firms, Type C, with higher technological needs would probably be interested in more extensive and more frequent dissemination of related technology to meet their larger appetites for technological information.

IAC's might be able to develop new services for small manufacturers based on successful TDI packages when the target audience has a continuing, well-defined need for technology. More data are needed to develop a better understanding for what small firms are most likely to use what sorts of technology through IAC services. The development of standardized, rather than custom, products appears to be the most cost efficient approach for IAC's to use in the small business market.



Small business leaders have stated that patent and marketing information are two other areas where small business needs help. Marketing data bases are available and used by IAC's now, and patent searches of the NASA base could be made available. As noted above, however, standardized products appear to be more likely as potential small business services and it is not clear how these types of data can be formatted as standard products which are useful to a variety of small business clients. An SBA data bank, which is presently in a formulation stage, will include current data on small business, statistics relating to numbers and types of businesses in various regions, with other information which could help a firm in its decisions concerning the use of technology and the evaluation of its profitability. It may be possible for the IAC's to use this SBA data bank in developing specialized products and markets in the small business sector.

The IAC's appear to have good potential for transferring NASA technology to small firms. The subsidized programs at NIAC/USC, NERAC and TAC can provide data which could be used to show other small firms what they can expect from IAC services. This technique has been used by NIAC/USC and TAC with some success in their efforts to attract small business clients. Further study of these programs should provide data to facilitate wider market acceptance by small manufacturers who cannot afford major investments in either information acquisition or R & D. Success patterns for these IAC programs could be described and made available to other IAC's for adaptation and use in their own market areas.

## NASA Management Technology

Since management problems account for the majority of small business failures, it is safe to say that management technology could be of value to most small firms during some periods of their growth, and especially for young, high-technology firms which experience the greatest and fastest change in their growth patterns and with accompanying increases in management demands. The first few years of a firm's operations are the "make, or break years," therefore, it is likely that firms in operation for less than five years would probably have the most urgent and perhaps most similar needs for such information. Many older firms, though not immune to management problems, also require such information, particularly if their growth is continuous, or if their growth patterns have changed considerably in short periods. If no change has occurred, a lack of proper management techniques could also account for the static situation. These older firms may have very different management needs than younger firms within the same industry, but may have some similar needs as firms of the same age and size in other industries.

NASA has documented and disseminated various engineering management techniques developed for the Agency's missions. The total number of management TSP's, however, is small compared to the number of product and process TSP's. In order to estimate how many management TSP's have been developed, a computer search was initiated using 10 management key words: accounting, administration, decision-making, inventory, management, organization, personnel, policy, scheduling and training. The results of this search appear in Figure V-1 which shows the number of management-related TSP's announced by year from 1966 through 1977. A

small number of examples included in Space Benefits 80-1 show that small firms can benefit from applying this technology.

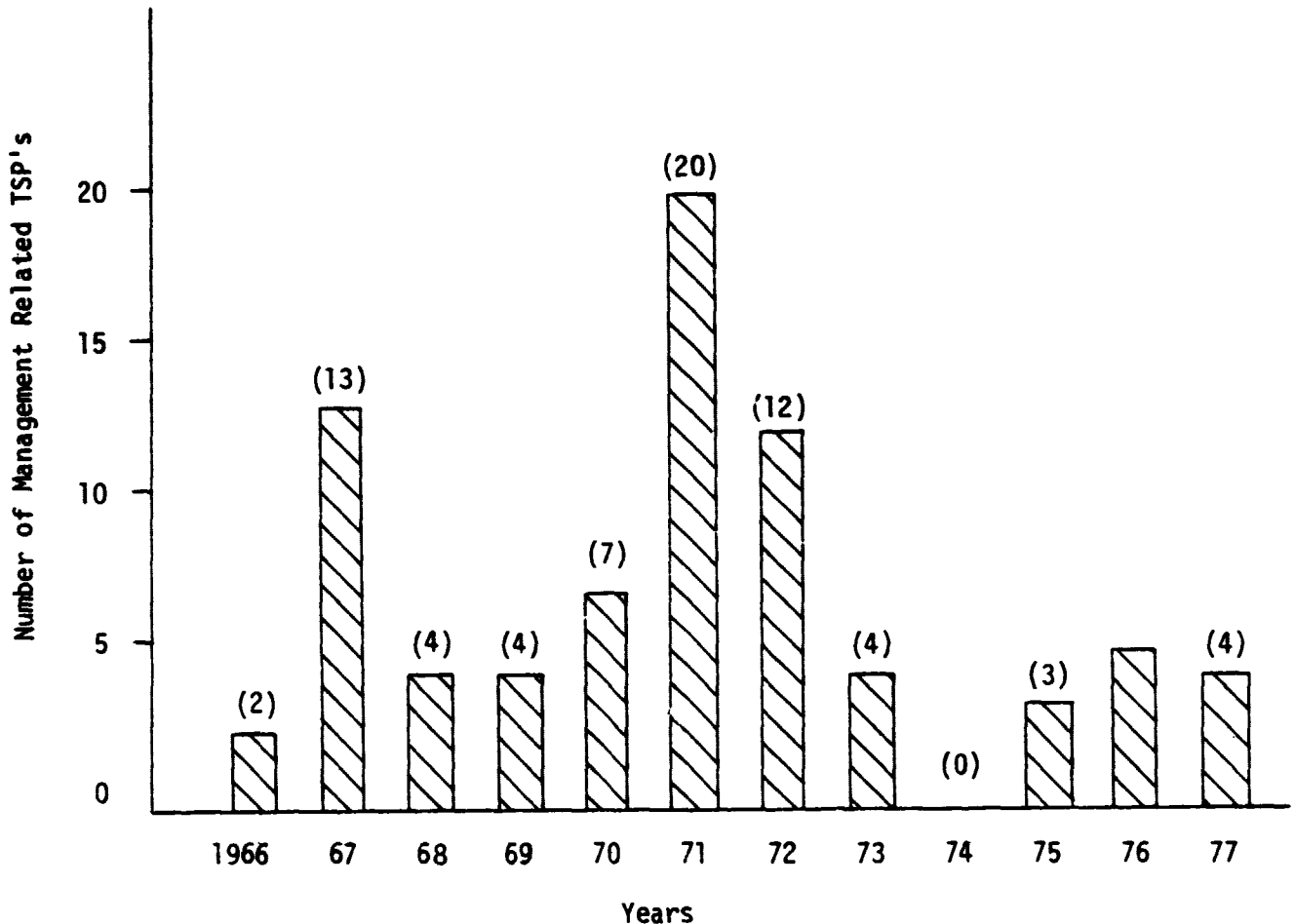


FIGURE V-1. MANAGEMENT TSP'S PRODUCED BETWEEN 1966-1967

A special effort to develop better reporting methods, packaging and dissemination for the Agency's engineering management technology could have two beneficial results related to small business. First, how-to publications with simplified engineering management systems and techniques could probably be used by many small manufacturers to reduce costs and increase their survivability. Second, such publications could also

provide a way to familiarize the Agency's new small business contractors with NASA management practices and expectations.

The major problem with increasing the number of engineering management TSP's is in finding reportable new technology of this type. New management techniques are reported less often by NASA personnel and contractors because they are less well-defined and less frequently documented than other engineering technology. Furthermore, the reported items are often complex management systems which are too expensive for small businesses to use.

#### Small Business Contracting

The use of NASA contract-related technology by small business was illustrated by examples in Section III. No systematic study of this transfer mode has been conducted to see if there are ways for the Agency to accelerate small business growth through its procurement activity. If this result could be achieved via contracts, the potential long term benefits are twofold: (1) greater cost efficiency in NASA procurement through the development of competitive, small business industries to produce some goods or services (e.g., solar cells) required by the Agency; and (2) greater total economic benefits through fundamental, long-term impacts on small, growing businesses as compared to minor, short-term impacts on large firms.

The first possibility is illustrated by the pavement grooving industry which the NASA Langley Research Center helped develop during the 1960's. The industry is about 12 years old, has about 10 small companies, and grosses between \$6 and \$10 million annually. This relatively small cost has paid for grooving over 40 percent of the nation's 400 airports controlled by the Federal Aviation Administration,

as well as many highway sections which are most dangerous when wet. The benefits (e.g., 80 percent reduction in California's wet highway accidents on grooved sections) far outweigh the grooving costs to the federal government. A competitive grooving industry, made up of small firms, is providing the government with a cost efficient way to increase aviation and highway safety. If technology diffusion activity of this sort can be repeated and directed, the Agency could develop new techniques for managing some procurement costs. The NASA Lewis Research Center is experimenting along these lines with a commercialization clause in its procurement of some gas turbine instrumentation. The various experiences and possibilities for stimulating growth in small business industries could be investigated for success/failure patterns and potential experiments to develop the concept further. This sort of small business procurement could also satisfy new requirements in the Small Business Innovation Act regarding small business prime contracting.

The historical role of small entrepreneurial companies (i.e., Type C firms) in the evolution of new industries is significant. The U.S. auto industry, for example, had about 1,500 small manufacturers in the early 1900's. The evolutionary process for a new industry typically starts with a number of variations in designs and practices to satisfy market demands. Some variations are better suited to market and financial conditions than others. Some firms grow under the existing conditions and others fail so the mature industry typically consists of a few large producers of standardized goods. It is much easier and cheaper to introduce new designs or practices in the early stages of an industry's evolution than it is in the later stages. It is also more difficult to predict which design or practice will be the most useful, so the safest

approach is to create multiple starts. As a transfer mode, small business contracting is a risky investment for NASA's technology transfer resources and the expected benefits may not occur for 5 to 20 years.

#### Summary

There are three reasons why NASA might consider developing a more active effort to enhance small business transfer activity. First, the TU Program can probably increase its cost benefit performance most easily by developing small business market segments for its services. Second, the Agency's procurement might be more cost efficient if competitive, small business industries could be developed through contracts to supply some types of products or services. Third, should successful methods be developed for transferring government technology to small businesses, they are potentially usable by other agencies for the same purpose. Although NASA technology will probably not produce major economic impacts in the small business sector, the TU Program can contribute significantly to a better understanding of how different transfer methods work simply by experimenting with various ways to pursue its dissemination goal.

In conclusion, past experience by TU Program transfer services provides more information on large business users of the services. The small firms have a different usage and success pattern so it has been difficult to develop this large heterogeneous market of potential users. With the data collection and analysis methods now available, these difficulties do not appear to be too serious and it should be possible to improve the Program's performance in generating small business transfer activity with reasonable efficiency.

**APPENDIX A**

**WHITE HOUSE CONFERENCE ON SMALL BUSINESS  
ISSUE RECOMMENDATIONS**

**APPENDIX B**  
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WHITE HOUSE CONFERENCE ON SMALL BUSINESS

ISSUE RECOMMENDATIONS

CAPITAL FORMATION & RETENTION

1. Replace the present corporate and individual income tax  
(1) schedules with more graduated rate scales, specifying the graduated corporate tax scale up to \$500,000.
2. Adopt a simplified accelerated capital cost recovery system  
(2) to replace the present complex Asset Depreciation Range (ADR) regulations, with provisions such as (A) immediately expensing capital costs less than a specified amount, (B) immediately expensing government mandated capital costs, and (C) the creation of a maximum annual benefit that may be derived from the system.
3. Revise estate tax laws to ease the tax burden on family-  
(4) owned businesses and encourage the continuity of family ownership.
4. Provide for a tax credit for initial investment in a small  
(7) business, and permit deferral of taxes for roll-overs of investments affecting small businesses.
5. Provide tax incentives in the form of a new security called a Small  
(9) Business Participating Debenture (SBPD) to provide a source of capital for small businesses.

MINORITY BUSINESS DEVELOPMENT

6. The President, by Executive Order, and Congress, by legislation, shall  
(14) establish mandatory goals for all Federal procurements and Federal funds or grants to states, localities, and public and private institutions, on a contract-by-contract or agency-wide basis for small businesses (35%); minority-owned (Black, Hispanic, Native American, Asian Pacific American, and other racial minorities) businesses (15%); and women in business (10%).
7. The President shall direct the Office of Management and Budget (OMB) to establish, as part of the budget process, a formal reporting and goal setting system, requiring all departments and agencies to specify and separately make public the resources they plan to make available to small businesses, minority-owned (Black, Hispanic, Native American, Asian Pacific American, and other racial minorities) businesses, and women in business. The departments and agencies shall also be mandated to publicly report the levels of attainment of these goals.
8. Congress and the Executive Branch shall ensure the effective implementation and enforcement of PL 95-507 by adopting the following changes/recommendations: (1) requiring the law or implementing regulations to provide that

the prime contractor set forth a narrative description of the sub-contract or sub-contract item; and (2) giving the Associate Administrator for Minority Business, within the SBA, the clear authority to enforce and monitor compliance with PL 95-507.

9. Congress shall (1) adopt a SBIC and MESSIC Investment Tax Credit Act to provide a 50% tax credit for corporations and individuals who invest in any issue of equity securities of SBICs and licensed MESSICs; and (2) authorize MESSICs to borrow long-term loans from the Federal Financing Bank at subsidized interest rates.
10. The President, by Executive Order, or Congress, by legislation, shall establish a National Minority Economic Commission to provide a centralized focus to the Federal effort to assist minority business enterprise. This Commission, a majority of which shall consist of non-government contractors, shall report directly to the President.

#### INNOVATION AND TECHNOLOGY

- (6) 11. Support and urge passage of S. 1860, the Small Business Innovation Act of 1979, and companion bill H. R. 5607, as presently drafted with flexibility for minor future amendments, covering: small business research and development set-asides; small business innovation and research programs (as already encompassed by H. R. 5126 and S. 1074); patents, retention; amendments to the Internal Revenue Code; and regulatory flexibility.
12. Existing Federal research and development procurement, assistance, and tax laws and policies must be modified and new laws enacted to:
  - 1) eliminate unfair advantages enjoyed by governmental agencies, non-profit organizations and educational institutions which compete with innovative small business in providing goods and services and, 2) mandate statutorily a national policy of reliance on small business, 3) prevent the Federal government from disseminating proprietary information, 4) prevent the Federal government, through the use of its own personnel including Federal Research Centers, from competing with small business.
13. Increase the amount of Federal research and development prime contracts awarded through small business set-asides by one percent per year of each agency's research and development budget, until the dollar value of the set-asides reaches at least ten percent of that agency's total annual research and development budget.
14. Clarify the "prudent man rule" to broaden it and insure that securities of small issuers are not excluded from those securities eligible for purchase by funds subject to ERISA, and exempt those securities from planned asset regulation issued by the Department of Labor.

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Issue Recommendation

15. Institute specialized capital gains treatment for generative capital invested in technology based firms starting with 25% in the first year, decreasing by 5% per year to zero after five years and, further, defer taxation on such gains whenever the proceeds from sale of investments is reinvested into a small business within the next twelve months.

**INFLATION**

- (3) 16. Balance the Federal Budget by statute in Fiscal Year 1981 by limiting total Federal spending to a percentage of the GNP, commencing with 20% and declining to 15%.
- (8) 17. Reform the Social Security System by including, where constitutionally possible, all public and private sector employees as contributors and more closely tie benefits to contributions to move the system toward actuarial soundness. Limit benefits to the original old-age and survivors benefits. Freeze the tax base and tax rate at the January 1980 level. Eliminate double dipping.
- (13) 18. Revise minimum wage standards by freezing standards at January, 1980 levels and establishing a two-tier minimum wage by exempting teenagers, seasonal workers and part-time workers.
19. Repeal the Davis-Bacon Act.
20. Provide greater incentives for savings and investment by eliminating income tax on investments and interest income up to \$10,000.

**VETERANS**

21. The President shall issue an executive order providing for the full and effective implementation of the provisions of the Small Business Act providing for "special consideration" for veterans (Part 116, Subpart A of title 87, United States Code, PL 93-237); to assist in carrying out the veterans "special consideration" provisions such executive order shall establish within the Small Business Administration an internal Veterans' Business Committee, the majority of whose members shall be veterans and whose purpose shall be to advise and assist the SBA in the development and implementation of programs and the formulation of policies necessary and appropriate to carry out the veterans' "special consideration" provisions of the Small Business Act and regulations pertaining thereto.

Such executive order shall require all appropriate agencies and departments of the Federal Government which engage in business assistance activities, such as procurement authority, to provide "special consideration" to veterans in order to significantly improve the quality of assistance to veterans and to provide support to veteran-owned businesses.

22. The President should establish an Interagency Committee on veterans in business. Not more than one third of such committee shall be non-veterans.
23. 15% of all Federal Procurement contracts and 15% of all SBA Direct and Guaranteed Loan Program Funds shall be set aside for veteran applicants. The SBA shall be responsible for utilizing the procurement automatic selection system (PASS) and other federal procurement source listings to implement veterans set-asides.
24. All legislation or regulations affording special treatment for women, minorities, the socially and economically disadvantaged or other special groups, should be amended to also provide priority for qualified veterans, including disabled veterans. Qualified veteran status alone shall entitle the veteran to equal treatment and inclusion in any such category or class.
25. SBA regulations shall include all disabled and/or Vietnam veterans in their definition of "socially and economically disadvantaged."

FEDERAL PROCUREMENT

26. The Federal Government shall be required by statute to contract out to small business those supplies and services that the private sector can provide. The government should not compete with the private sector by accomplishing these efforts with its own or non-profit personnel and facilities. Small business generally - 50% which shall include the following: minority-owned businesses 15%, business owned by women 10%.
27. Procurement agencies should break down large requirements (including those for research and development) into smaller parts where feasible to permit solicitation from, and award to, small businesses.
28. The Federal Government should contract out supplies and services to private industry (particularly small and minority business) and should not compete with the private sector either through the use of its own personnel or through non-profit organizations such as the Federal Research Centers, educational institutions or other non-profit entities.
29. The Office of Federal Procurement Policy should develop a new set of procurement regulations applicable to procurements under a special amount from all businesses. This "second-tier" regulation should eliminate clauses, procedures, reporting requirements, etc., applicable to large systems procurement which are currently imposed on small businesses, as well; and to the extent possible, apply to subcontracts with small businesses.
30. Congress should adopt legislation establishing separate mandatory goals for all federal procurements and federal funds or grants to states, localities, and public and private institutions on a contract by contract basis or agency-wide basis for small business (35%), minority-owned (Black, Hispanic, Native American, Asian Pacific American or other racial minorities) businesses (15%), and women in business (10%).



WHCSB

Issue Recommendation

ENERGY

31. The Federal Government should open public lands to energy exploration and production under regulation which provide reasonable environmental protection with:
  - (a) a 30% small business set-aside
  - (b) fixed time limits for statutory environmental analysis
  - (c) a 5-year limit on lease terms to encourage rapid development
32. Government must use any new tax income from energy production and development for the future production and development of energy in the private sector, until the U. S. is energy self-sufficient. Small business should have tax exemptions and appropriate set-asides.
33. The U. S. Government shall encourage the immediate expansion of nuclear and coal-powered electric generating capacity. Research efforts directed toward power technology should be expanded.
34. Congress should encourage substantial direct and investment tax credits for the implementation of all forms of conservation and alternative energy. Additionally, investments of up to \$150,000 per year should be expensed.
35. Action should be taken to immediately remove price and allocation controls on crude oil and all petroleum products.

WOMEN IN BUSINESS

- (11)
36. Private lending institutions should be required to provide equal access to commercial credit for women in business. The Federal Reserve Board should establish record keeping requirements for commercial loans to women which will permit effective monitoring of performance under the Equal Credit Opportunity Act. The Small Business Administration should make bank certification available to as many commercial banks and other lenders as possible and establish targets for increasing the dollar volume of loans made to minority-owned and women-owned businesses, as one of the criteria for recertification.
  37. The President should initiate by Executive Order and Congress should enact legislation establishing mandatory goals and reporting requirements for all Federal procurements and procurements resulting from Federal funds and grants to states, localities and public and private institutions for small businesses on the basis of 50% for small businesses. The 50% shall be distributed so that 15% of all procurements shall be targeted for businesses owned by socially and economically disadvantaged persons

WHCSB  
Issue Recommendation

(i.e., those businesses owned and operated by Blacks, Hispanics, Native Americans, Asian Pacific Americans and other racial minorities), and 10% of all procurement shall be targeted for women-owned businesses as defined in Executive Order 12138. And, further, that Congress should amend the Small Business Act to provide incentives to Federal prime contractors for subcontracting with women-owned businesses; provided however, that such an act does not include women-owned businesses as a category or class of socially and economically disadvantaged small business.

38. The Small Business Administration should identify existing public and private management training programs, evaluate their effectiveness for women entrepreneurs and increase funding to those found to be effective.
39. Evaluate all Federal government employees in positions which impact on women and minorities, particularly loan officers, procurement officers and management assistance officers, in part on the basis of their performance on behalf of women and minorities.
40. The Small Business Administration shall establish a bonding program that permits the waiver of bonding requirements for Federal contractors who are small business owners. This program shall be available to all small business owners who have been:
  - 1) unable to obtain bonding from any other source, and
  - 2) certified as competent by the SBA.

GOVERNMENT REGULATIONS AND PAPERWORK

- (5) 41. Congress shall exercise its oversight function with the assistance of the General Accounting Office, instituting sunset reviews of all laws, regulations, and agencies, to ensure that none exceeds original congressional intent. Sunset reviews, in an appropriate time frame (not less than every five years) should include economic impact analysis and proposed agency budget reductions, leading to re-enactment of each agency's enabling legislation to permit its continued existence, or to reduce its size and cost.
  - (a) Establish a Regulatory Review Board composed of representatives from the Executive Branch, Congress and small business owners, with responsibility for impact statements and cost controls.
  - (b) Congress shall exercise line-item veto over regulations within a specified time through congressional oversight committees, with one-house floor vote.
- (12) 42. Small business should be eligible for magistrate review of agency civil penalties, and reimbursed for court costs, reasonable attorney's fees, and damages from administrative action, if successful in civil disputes with the Federal Government, including IRS.

WHCSB  
Issue Recommendation

- (a) Such costs and fees to come from the operating budget of the agency.
  - (b) Magistrates will be appointed and be responsible to the judges in each Federal Judicial District.
  - (c) With burden of proof on the agency to defend its action.
43. The Office of Management and Budget should be designated the lead agency for both Federal regulations and paperwork of all agencies and programs (specifically including IRS), with responsibility for forms clearance, paperwork reduction, simplification and elimination; coordinating regulations and cost control oversight; requiring agencies to submit to OMB an economic analysis measuring administrative and compliance costs, particularly for small business, of all proposed regulations and paperwork.
44. All Federal agencies should have the power to implement a tiered system of regulation. This should include the power to minimize and exempt small business from various regulations and reporting requirements as well. All new regulations should be designed to take into account the size and nature of the regulated business. All present regulations should be reviewed to see if they are still required.
45. When developing rules, forms and guidelines, regulatory agencies must consult with small business representatives from affected industries and advocates assigned to each agency.
- (a) Consult SBA Office of Advocacy and small business trade associations who should be given sufficient authority and time (90-180 days prior to publication of notice of proposed rule-making) to influence regulators if a proposed rule and/or form would have an impact on small business.
  - (b) Such proposed rules should reflect less formal administrative procedures for small business.
  - (c) Agencies make available timely information and assistance, within 30 days in writing.

ECONOMIC POLICY AND GOVERNMENT PROGRAMS

- (15) 46. Priority (6): Require that all government agencies which develop fiscal, monetary, legislative and regulatory policies/practices shall submit small business "economic impact" statements that require the regulatory agencies to identify the anticipated benefits and to justify the costs of Federal regulatory requirements to small business. In addition, all regulatory policies shall be subject to sunset provisions to be reviewed every 5 years in order to insure that only cost effective regulations shall be maintained and retained in the future.

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- (10) 47. The Office of Advocacy must be maintained, reinforced and expanded so that activity be not less than 5% of the SBA salary and expense budget. The legislative mission of Advocacy must be considered the number one priority of SBA and the Office of Advocacy. The independence of that function of the Office of Advocacy must be protected so that it may continue to have the confidence of the small business community. SBA's Advocacy budget should be devoted to economic research and analysis, as well as, small business advocacy. Small business advocates, under the direct supervision of the SBA Office of Advocacy, shall be assigned to OMB, Federal Reserve Board, Treasury, International Trade Policy Committee and other regulatory agencies.
48. The merger and acquisition anti-trust laws should be amended to: (1) inhibit monopoly and conglomerate growth of giant companies, provided safeguards are built in to protect the needs of small business, (2) prohibit dual distribution that adversely affects wholesalers, distributors, dealers, retailers, and franchises; and (3) prevent the termination or non-renewal of wholesalers, distributors, dealers, retailers and franchisees without good legal cause.
49. The SBA should be directed to implement the following changes:
- A. The duties of the Administrator of the SBA shall include the additional function of chairing a new group, within the Executive Branch, to be known as the "Economic Policy Planning Committee for Small Business" to advise the President of small business matters. The new committee shall consist of the following: high level representatives of the Departments of Commerce, Treasury, and Council of Economic Advisors.
  - B. The SBA Bank Certification Program should be expanded so that the SBA can devote more of its resources in terms of personnel and funding to small business advocacy.
  - C. The Office of Advocacy must be maintained, reinforced and expanded so that activity be not less than 5% of the SBA salary and expense budget. The independence of the function of the Office of Advocacy must be protected so that it may continue to have the confidence of the small business community. Small Business Advocates should be assigned to OMB, the Federal Reserve Board, the Treasury Department and regulatory agencies, under general guidelines from the Office of Advocacy of the SBA.
50. Small business representation in economic and regulatory decision-making should be increased. This should include, but not be restricted to the following steps by the President:
- 1. Seek the Counsel of the SBA Administrator and representative small business executives in developing policy.
  - 2. Appoint a small business executive as a senior advisor on the White House Domestic Policy Staff.

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3. Direct that small business advocates be assigned to the OMB, FRB, Treasury Department and regulatory agencies, under general guidelines from the Office of Advocacy at the SBA.
4. Appoint small business persons to all national boards, commissions and advisory committees whose work impacts on small business.

#### INTERNATIONAL TRADE

51. Congress should broaden the tax deferral options of the Domestic International Sales Corporation and provide for the development of an American Trading Company which would automatically qualify as a DISC. Tax deferral options should include the following additional provisions for DISCs: 1) allow for deduction of twice the monies expended for participation in any bona fide overseas trade fair by a DISC; 2) allow for the deduction of twice the amount of premiums paid to Eximbank and FCIA, as legal deductions prior to payment of DISC taxes; 3) increase the \$100,000 exemption clause to \$500,000; 4) provide for a graduated tax on "deemed distribution" from \$500,000 for \$50 million, and a standard rate of 50% levied on over \$50 million; 5) exempt new DISCs from any "deemed distribution" requirement for at least the first three years of operation; and, 6) provide for the elimination of existing incremental provision of DISC regulations. Congress should provide within the tax structure an "Exporter's Allowance" or tax deduction which would apply in the trade of all goods abroad by granting an allowance for 75% of the marketing expenditures incurred by the exporter.
52. Eximbank should establish a special small business founding program through commercial banks, and should consider discounting loans to support international sales and should develop a cooperative program with the SBA for pre-export financing.
53. The Federal government should establish field one-stop service shops to include export services of all Federal agencies under the guidance of the Department of Commerce.
54. The President and Congress should consolidate under an existing cabinet level department, a unified world trade administration. It would be responsible for all trade policy functions of the various agencies and departments. Its objective would be to maximize the international competitive strengths of U.S. Small Business with support and goals for minority, women-owned and disadvantaged business and specific programs developed to utilize their units of, technological, educational, cultural, language and political expertise.

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55. Congress should provide for support and expand the use of all officially recognized Trade Fairs, Exhibits, and Trade Centers abroad with small business participation; continue to encourage the Department of Commerce to increase the promotion of foreign buyer and foreign visitor travel to the United States; and develop a program utilizing the cultural, language and political expertise of all Americans, especially ethnic groups, to assist in preparing, implementing and utilizing a sales package for use in expanding International Trade in all world markets.

EDUCATION, TRAINING AND ASSISTANCE

56. A Small Business Educational Task Force for entrepreneurial educational training shall be appointed by the President and coordinated by the Office of Advocacy. Task Force members shall come primarily from small business to initiate, promote and develop the incentives for demographically, projectionable, formal, business planning and case history-type continuing education and public awareness (through all media) in small business. Mandate to the Task Force shall be to come up with self-liquidating (pay for themselves) programs for the benefit of small business. This should be achieved within 120 days. (Priority 3)
57. The Small Business Administration's management assistance programs should be strengthened and expanded by allocating a greater portion of the Agency's total resources to reflect an increased emphasis on management assistance rather than the traditional emphasis on financial assistance. (Priority 4)
58. A National Policy should be established for the support of entrepreneurial education and training, continuing education and management assistance, provided by the public and private sector, as an opportunity for every American who wishes to own his or her small business and should receive recognition as a priority from the highest levels of government. (Priority 15)
59. Establish "One-Shop Shops" under the coordination of SBA for small business assistance programs utilizing effective information systems and management assistance programs to serve the small business community of the local level, with primary implementation occurring through the private business sector, existing agencies and existing organizations.
60. Congress should enact legislation that would provide tax credits or other tax incentives for:
  - A. Expenses incurred to educate small business owners and operators regarding the management of business; and
  - B. Expenses incurred to conduct continuing education and training and to provide on-the-job entrepreneurship experience.